Lumenera Network Camera
User's Manual
Release 1.8.1

Lumenera corporation

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1

Introduction

1.1 The Lumenera Network Camera Family

Lumenera Network Cameras are designed to satisfy both general-purpose and high-end surveillance applications, delivering outstanding image quality. The cameras use on-board JPEG compression to deliver high quality images over a standard 10/100baseT Fast Ethernet connection. In video surveillance applications, Lumenera Network cameras work with an extensive list of third-party NVR/DVR software and hardware to provide complete video management solutions. Support for different camera models is kept uniform using a common Application Programming Interface (API) to the greatest extent possible.

Lumenera's product line is unique in its breadth, with resolution range from VGA to 11 megapixels and a choice of several CMOS and CCD image sensors in both color and monochrome types. Most models use C/CS- mount lenses commonly found in CCTV and factory automation, can be powered using Power over Ethernet (PoE), and are available with an integrated day/night filter option for use with active-infrared illumination. For demanding applications such as low-light surveillance, traffic enforcement, and industrial process monitoring, Lumenera provides high-sensitivity, low-noise CCD's with global shutter. Large-format models use off-the-shelf 35-mm motorized lenses to provide exceptional image quality and sensitivity.

The Li-series intelligent network cameras provide additional features including embedded rules-based video content analysis, audio input and output, and an analog video output for use in installation.

The description of the online Graphical User Interface (GUI) to the cameras and the API applies specifically to the camera firmware version 1.8.1. Extensions specific to the Li series intelligent cameras refer to firmware version 2.3.1.

1.2 Where to Find Documentation

All camera documentation can be found in the C:\Program Files\Lumenera Corporation\Documentation folder. The documentation that is provided includes this manual, the Camera API manual, camera Application Notes and White Papers.

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1.3 Technical Assistance

If you need assistance with the installation or use of the software, or, if you need help with general camera operation, please contact the Technical Assistance Centre (TAC) via email at:

support@lumenera.com

or by phone at +1-613-736-4077 (press 1 from the auto attendant).

To obtain the latest software release and other technical information you may visit our technical support website at:

http://www.lumenera.com/support/index.php

Our support website contains technical information available to the general public such as Frequently Asked Questions (FAQ's). For our Lumenera customers we provide a Knowledge Base with more product specific solutions and a Download Centre for customers to obtain the most recent software releases.

As a customer, you will need to provide the TAC with some basic information to gain access to the customer Knowledge Base and the Download Centre. Please provide the following details via email to support@lumenera.com to obtain a user name and password:

- Your name, Company Name, address and telephone number
- Your camera model and serial number
- Your purchase information (e.g. did you purchase from an OEM or distributor?)

Upon providing the above information, you will receive your access information via email from a TAC representative.

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2

Installing the Camera

2.1 Power Supply and Connection

This section describes the electrical connections for power and auxiliary functions of the Lumenera Network Cameras.

Power, general purpose input/output (GPIO), DC auto-iris connections, and RS232 serial communications can all be found on the back panel of the camera. In addition, new Li-series intelligent cameras provide connections for BNC analog video output and a two-way audio jack.

2.1.1 Before You Proceed

Please observe the following precautions to prevent damage and protect your warranty.

- Power requirements vary depending on the camera model. Please take care to follow all power requirements marked on the camera case and stated in this manual.
- Wiring to the unit must be in compliance with electrical codes.
- If you are using an AC power supply (option for the Li175 camera), it must be floating and not tied to ground, otherwise permanent damage may result.
- Do not apply excessive voltage or current to the auxiliary connections (DC iris, GPIO, RS232, analog video out, audio in/out, etc.).
- Use only Power over Ethernet injectors or switches that are certified as IEEE 802.3af compliant.
- Maintain temperature from -10 ºC to +50 ºC (14 ºF to 122 ºF) during operation.
- Maintain relative humidity from 5% to 95% non-condensing during operation.

2.1.2 Determining Your Camera Model

Please locate your camera model in the table below and proceed to the page indicated for step-by-step installation instructions.

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Table 2-1 Lumenera Network Camera Models

Model	Resolution megapixels	Video analytics option	Day-Night option	Lens mount[1]	Section of this Guide
Le045	0.3 (NTSC)	No	YES	CS	2.1.2.3
Li045	0.3 (NTSC)	YES	YES	CS	2.1.2.3
Le075	0.3 (VGA)	No	YES	CS	2.1.2.1
Le165	1.4 (SXGA+)	No	YES	CS	2.1.2.1
Li165	1.4 (SXGA+)	YES	YES	CS	2.1.2.3
Le175	1.3 (SXGA)	No	YES	CS	2.1.2.1
Li175	1.3 (SXGA)	YES	YES	CS	2.1.2.3
Le259	2.1 (HD1080)	No	No	Canon EF	2.1.2.2
Le275	1.9 (UXGA)	No	YES	CS	2.1.2.1
Le375	3.1 (QXGA)	No	YES	CS	2.1.2.1
Le575	5.0	No	YES	CS	2.1.2.1
Le11059	10.6	No	No	Canon EF	2.1.2.2

1 Use Lumenera part C-to-CS mount 5-mm adapter to mount a C-mount lens on a CS-mount camera

2.1.2.1 Standard Format Cameras

The Le-series standard-format Network cameras offer an industry-leading selection of CMOS and CCD imagers ranging from VGA resolution to 5 megapixels. Megapixel CMOS imagers provide unsurpassed image detail. For challenging applications such as highway traffic and night surveillance, our low noise, high sensitivity, global-shutter CCD's are unique among IP CCTV products. All standard-format Le-series cameras are also available with a field-proven true day/night option. The daytime infrared-cut filter guarantees accurate color. The night time clear glass maximizes sensitivity and enables the camera to be used with active infrared lighting.

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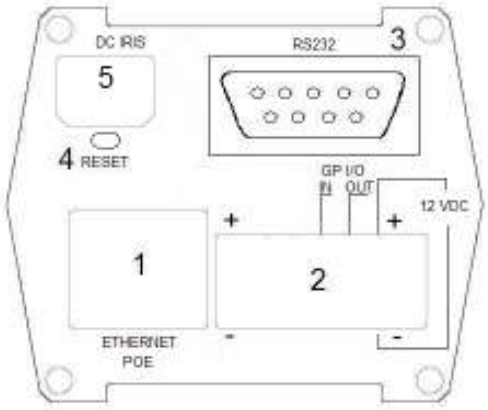
Power and connectivity

Table 2-2 Le-Series Standard-Format Power and Interface Connections

Model	IEEE 802.3af PoE	External power option[1,2]	Max. power draw	4-wire DC auto-iris	I/O	RS232	Network
Le075	YES	12 V DC	4 W	Yes	1 in, 1 out	Male DE-9	10/100 baseT
Le165	YES	12 V DC	5 W	Yes	1 in, 1 out	Male DE-9	10/100 baseT
Le175	YES	12 V DC	4 W	Yes	1 in, 1 out	Male DE-9	10/100 baseT
Le275	YES	12 V DC	4 W	Yes	1 in, 1 out	Male DE-9	10/100 baseT
Le375	YES	12 V DC	4 W	Yes	1 in, 1 out	Male DE-9	10/100 baseT
Le575	YES	12 V DC	4 W	Yes	1 in, 1 out	Male DE-9	10/100 baseT

1 Use Lumenera part Lu8501 110-240 VAC 50/60 Hz IN, 12 VDC/2A OUT universal supply for indoor use.
2 Prior to August 2008, non-PoE cameras accepted 9-24 V AC/DC external power.



1 - Ethernet / PoE RJ45 jack
2 - 10-pin locking power & input-output connector
3 – RS232 serial port
4 – Factory reset switch
5 – 4-conductor DC-auto-iris socket.

Figure 2-1 Le-Series Standard-Format Camera Back Panel

2.1.2.2 Large Format Cameras

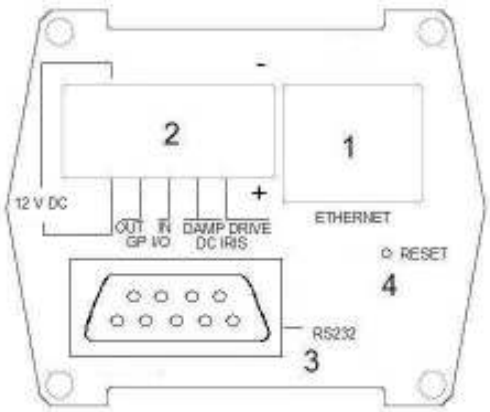
The Le-series large format Network cameras offer advanced high-resolution CCD imagers ranging up to 11 megapixels. These cameras offer exceptional support where panoramic views and digital zoom are essential. The image geometry is also configurable, enabling, for example, imaging in a wide rectangular region of interest spanning multiple lanes of traffic, while excluding the sky and the foreground. Support for Canon EF-mount and compatible motorized 35-mm SLR lenses provides for remote control of focus and iris over IP, reducing the need for periodic maintenance. Canon IS lenses are supported where active image stabilization is required.

Power and connectivity

Table 2-3 Le-Series Large-Format Power and Interface Connections

Model	Power input[1]	Max. power draw	4-wire DC auto-iris	I/O	RS232	Network
Le259	12 VDC	10 W	Use Le902	1 in, 1 out	Male DE-9	10/100 baseT RJ-45
Le11059	12 VDC	15 W	Use Le902	1 in, 1 out	Male DE-9	10/100 baseT RJ-45

1 Use Lumenera part Lu8501 110-240 VAC 50/60 Hz IN, 12 VDC/2A OUT universal supply for indoor use.



1 - Ethernet RJ45 jack
2 - 10-pin locking power & input-output connector
3 – RS232 serial port
4 – Factory reset switch

Figure 2-2 Le-Series Large Format Back Panel

2.1.2.3 Intelligent Cameras

The Li-series Network camera family is DSP-based to provide optional ObjectVideo™ OnBoard™ video analytics. Video analytics options are indicated by -OV1, -OV2, and -OV3 suffixes to the camera part numbers, where -OV3 indicates the highest functionality. Camera models include the following:

- Le045 / Li045: ultra-wide dynamic range for capturing high-contrast scenes
- Li165: state-of-the-art 1.4 megapixel CCD camera for high sensitivity
- Li175: 1.3 megapixel CMOS camera

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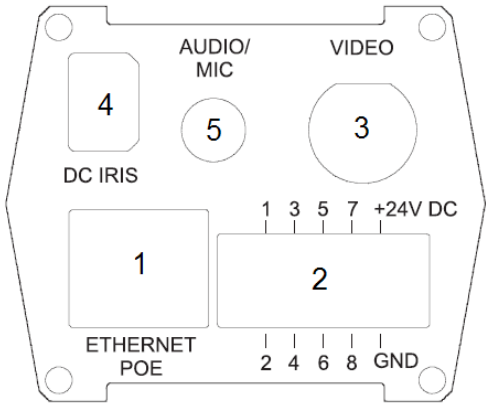
Power and Connectivity

Table 2-4 Li-Series Power and Interface Connections

Model	IEEE 802.3 af PoE	External power option[1]	Max. power draw	Analog video OUT	Audio IN/OUT	4-wire DC iris	I/O	RS232	Network
Le045	YES	24 VDC	6 W	BNC	Yes	Yes	1 in 1 out	Terminal block	10/100 base T RJ-45
Li045	YES	24 VDC	6 W	BNC	Yes	Yes	1 in 1 out	Terminal block	10/100 base T RJ-45
Li165	YES	24 VDC	6 W	BNC	Yes	None	1 in 1 out	Terminal block	10/100 base T RJ-45
Li175	YES	24 V AC/DC	6 W	BNC	Yes	Yes	1 in 1 out	Terminal block	10/100 base T RJ-45

1 Use Lumenera part Lu8401 110-240 VAC 50/60 Hz IN, 24 VDC/1A OUT universal supply for indoor use.



1 – Ethernet / PoE RJ45 jack
2 - 10-pin locking power & input-output connector
3 - Analog VIDEO output
4 – 4-conductor DC-auto-iris socket
5 - Audio jack for line out and mic in

Figure 2-3 Li-Series Camera Back Panel

Ethernet/PoE connection

The "ETHERNET POE" RJ-45 jack is used to connect a 10/100baseT Fast Ethernet data cable to the camera to provide a network connection. If the cable is connected to a Power over Ethernet (PoE) switch then no external power supply is required. When working with a non-PoE switch, you may use a PoE injector. PoE devices should comply with the IEEE 802.3af standard. To power on the camera, simply connect a CAT5e cable between the camera's RJ-45 jack and a port on your network/switch that supports PoE.

If PoE is not available, you must supply power using the terminal block connector (item 2 in Figure 2-3 above). The recommended universal power supplies are:

- Lumenera part Lu8501 (12 VDC) for all Le-series cameras.
- Lumenera part Lu8401 (24 VDC) for all intelligent (Li-series) cameras.

Note: Be sure to apply the correct polarity.

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The green link light will pulse during the camera power-up sequence. For the Le-series cameras, the orange/amber LED will also be active during the boot cycle. When the camera is finished booting, the green link LED will be lit continuously whenever a working network connection is available.

You may locate the camera on your network using the LeCam Client application provided on the CD-ROM that comes with your camera. Detailed camera settings can be controlled from a web browser based user interface. Refer to Section 2.4 for other options to determine your camera's IP address.

2.2 Installation CD-ROM

Lumenera Network cameras do not require any special-purpose software. You can access any camera through a web browser by entering the camera's IP address. The CD-ROM that comes with your camera provides additional applications, tools and documentation to help you use and understand your Network camera.

The following files are installed when you run the installation program located on the CD-ROM.

2.2.1 Application Software

The LeCam Client demonstration application is provided to quickly find and control Lumenera Network cameras on your network. The application can be found in the following installation path:

C:\Program Files\Lumenera Corporation\

A shortcut to this application is added to the Start Menu at the location selected during installation. The default location is:

Start > Programs > Lumenera

2.2.2 Example Code

The default location for example code is:

C:\Program Files\Lumenera Corporation\Sample Code

The source code consists of a complete Microsoft Visual C++ 6.0 project. The libraries are also compatible with Visual Basic, Visual C# and Borland C++ Builder.

2.2.3 Documentation

Documentation consisting of this User's Manual, the API Reference Manual and the latest available Application Notes and White Papers are installed in:

C:\Program Files\Lumenera Corporation\Documentation

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2.2.4 Installation Procedure

Below is a list of tools and parts that are necessary to setup and install your Network Camera.

Power Connections:

- 10-terminal power & I/O connector (included)
- Power source (see Table 2-2, Table 2-3, and Table 2-4 for proper power source for your camera)
- 18 to 28 AWG wire for all external power supplies

Network Connection:

- Lumenera Ethernet Camera Installation CD-ROM (included)
- CAT5/CAT5e twisted pair cable, 10/100baseT Ethernet connection
- CAT5/CAT5e Power over Ethernet where applicable

Lens:

- Small-format: CS-Mount lens or C-Mount with Lu901 5mm adaptor
- Large-format: Canon EF-mount 35 mm lens (or compatible lens)

Refer to Table 2-1 for the correct optical format for your camera model.

Note: Install a lens that matches the sensor size specified for your camera. Avoid using a lens designed for a smaller sensor (e.g. 1/3" format lens on a 1/2" format sensor) as undesirable vignetting (corners will be darker than the rest of the image) will occur.

2.2.4.1 To setup and install your camera follow the steps below.

1. Connect an Ethernet cable from a network switch to the camera's RJ45 port. Use a crossover Ethernet cable if connecting directly to a computer.
2. Ensure your power source conforms to the proper power source listed for your camera. Section 2.1 has a complete listing of all supported power sources for each camera model.

   Note: Using an incorrect power supply may damage the camera and will void your warranty. Be sure to apply the correct polarity.
3. Before applying external power, connect the power wires to the power terminals. Insert a small flat-head screwdriver in the square hole adjacent to each power terminal to open its locking connector.
4. Apply power. For Le series cameras, the orange boot light on the RJ45 socket will be active. For Li series cameras, the green link light will be active. It typically takes about 45 seconds to complete the boot process. The green link light will turn on indicating that the camera has a valid Ethernet connection.

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5. Locate the camera on the network. The camera is factory programmed to obtain a dynamic IP address using DHCP. If the network does not have a DHCP server, the camera defaults to use a fallback IP address of 192.168.1.222.
6. Connect to the camera using a web browser or by using the LeCam Client application included with the CD-ROM which is described in more detail in Chapter 3. Use the camera's IP address (e.g. http://192.168.2.183) to connect to the on-camera web server in a web browser to view images and change camera settings. This can be executed manually or by selecting a camera in the Camera Browser Tool and clicking on the Home Page button.

The following sections provide more specific connection setup and use information.

2.3 Connecting To Your Camera

To connect to your camera, both the camera and your PC's network port should be connected to the same local area network through a network switch or router. If you are connecting directly between the camera and the PC using a single cable, it must be a cross-over Ethernet cable.

Every Lumenera Network camera has two IP addresses that can be used to access it. The first IP address is configurable to either a static IP address or a dynamic IP address that is acquired from a DHCP server.

The second IP address is the pre-determined, non-configurable link-local IP address which is based on the camera's MAC (Media Access Control) address. The MAC for Lumenera cameras is indicated on a white label affixed to the camera body. The camera's MAC is a set of 6 hexadecimal values, for example:

```
00:0B:E2:0D:12:CD
```

The values `00:0B:E2` identify Lumenera as the manufacturer. The last 3 octets (`0D:12:CD` in the example above) are unique to a particular camera.

The following section will walk you through the different ways to locate and configure your camera on the network.

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2.3.1 Using the LeCam Client Application on the CD-ROM

The LeCam Client application allows you to find any Lumenera Network camera that is on the same sub-net as the computer running it. It is based on the ZeroConf protocol similar to Apple's Bonjour application. The LeCam Client application has two prerequisites, .NET 2.0 and Bonjour for Windows. This application is explained in more detail in Chapter 3.

2.3.2 Using Apple's Bonjour Applet

Apple Macintosh computers that are equipped with Bonjour (formerly called Rendezvous) may access the camera by name. It uses the ZeroConf protocol to find and query the camera's information. The name consists of the camera model name plus the last 6 digits of the camera's MAC address

On a Windows PC, the Network camera may be discovered by using Apple's Bonjour applet to search for local web servers. You can get more information on the Bonjour applet on Apple's website (www.apple.com/bonjour). A plug-in for Microsoft Internet Explorer for Windows can be downloaded from the same web site, or you may use the installation file included on the CD-ROM in the following path:

C:\Program Files\Lumenera Corporation\

An example ZeroConf camera name for the LE175 1.3 megapixel camera with a MAC address of `00:0B:E2:0D:12:CD` is LE175-0D12CD. The camera can be located by entering the URL http://le175c-0d12cd.local/ in a web browser. This default URL will change only if the camera name is edited in the Network section of the Admin Mode tab of the camera's web interface.

Once you have installed the Bonjour applet, there will be a link to it within your Internet Explorer web browser, as shown in Figure 2-4.

High-performance digital cameras for industrial, scientific and s...
http://www.lumenera.com/
Google
Bookmarks
5 blocked
Settings
High-performance digital cameras for indust...
Page
Tools
Help
Bonjour
Research
Messenger
Lumenera corporation
contact us
Products
Support
News & Events
Partners
Careers
About Us
Image Gallery
Lumenera wins OCRI Technology Company of the Year and OBJ's Ottawa's Fastest Growing Company Awards!
Lumenera Corporation is a leading developer and manufacturer of digital cameras for industrial, scientific and security markets. Located in Ottawa, Canada, Lumenera provides an extensive range of high-performance digita cameras with unique combinations of speed, resolution and sensitivity to satisfy the demands of today's imagin applications. Lumenera also offers custom design services to Original Equipment Manufacturer (OEM) partners requiring specialized hardware and software features. Read more about Lumenera >
Internet
100%

Figure 2-4 Bonjour Toolbar in Internet Explorer 7

By selecting this link, a new frame will appear on the left side of the browser window. In this frame, you will see all network devices that can respond to the ZeroConf requests including all accessible Lumenera Network cameras, as shown in Figure 2-5.

To select a camera from this list, simply double-click it in list provided. The camera's main webpage will appear in the right part of the browser.

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Figure 2-5 Selecting a Specific Camera Using the Bonjour Toolbar

2.3.3 Using a Dynamic IP Address

As a factory default setting, Lumenera Network cameras are set to look for a DHCP server to dynamically assign an IP address to the camera. This makes the cameras easy to use during set-up on most office networks. The camera can then be found using the LeCam Client application.

You can get the assigned IP address by going to the Network section on the Admin Mode tab on the camera's web interface. It is located in the IP address field on this web page.

2.3.4 Using the DHCP fallback IP Address

If no DHCP server is located at boot time, the camera will attempt to use a fallback IP address of `192.168.1.222`.

2.3.5 Using Its Link-Local IP Address

The link-local IP address can be useful for locating your camera initially, for identification and location for network administrators, and for troubleshooting purposes. This is especially true when a DHCP server is unavailable.

The link-local IP address of the camera is derived from the camera's MAC address. It is located within the 169.254.93.0 address block.

A Microsoft Excel spreadsheet for finding the link-local address from the MAC is available from the online Knowledge Base or can be sent to you by email through

a request our TAC group at support@lumenera.com, by providing your camera's unique MAC address.

To calculate the link-local address of your camera yourself, use the following equation which is based on the last 4 hexadecimal digits (last 2 octets) of the camera's MAC address:

```
169.254.[(93+A)%256].[B]
```

where,

`%` = take the remainder of the division of `(93 + A) / 256`
`A` = the 3rd and 4th last hexadecimal digits, and `B` = the last two hexadecimal digits.

For example, consider a camera with the following MAC address:

```
00:0B:E2:0B:01:6D
A = 1 (01 hexadecimal)
B = 109 (6D hexadecimal)
```

The camera's link-local IP address is `169.254.94.109`.

```
l set use_link_local=0
```

Refer to Sections 5.7 and 5.8 for information on telnet and serial consoles.

To disable the link-local address in a web browser use:

```
http://169.254.94.109/cgi-bin/set?use_link_local=0
```

Be sure to substitute the actual camera IP address for the example shown. To apply the change, you must save settings to store the updates in the non-volatile memory, and then reboot the camera. Links to the Save Settings and Reboot Camera options are available in the Admin Mode tab in the camera's web interface. You can also use API functions to save and reboot in a telnet or serial console:

```
l save_settings
l reset
```

or web browser/CGI instruction:

```
http://169.254.94.109/cgi-bin/save_settings
http://169.254.94.109/cgi-bin/reset
```

After 30-45 sec., the camera will complete booting. It will not reappear in the same browser window, since you must now specify a valid IP address other than the link-local address.

2.3.6 Setting a Static IP Address for the Camera

In some cases, it may be beneficial to assign a static IP address to the camera so that it is maintained regardless of what else happens on the network. This may be the case when using a Network Video Recorder (NVR) or Digital Video

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Recorder (DVR) for video recording and management. This section describes how you can set a static IP address for the camera.

Once communication with the camera is established using the web browser interface, it is easy to set the IP address of the camera.

1. Go to Admin Mode tab on the camera's web interface. Click on the link for the Network menu. Refer to Section 6.9 for detailed information on using the Network settings.
2. Click the option button to set DHCP off.
3. Enter the new static IP address for the camera, e.g. `192.168.2.78`.
4. Enter the new netmask, e.g. `255.255.255.0`.
5. The gateway should be optional. An example is `192.168.2.1`. Consult your Network Administrator for more information on what this value should be.
6. Click on the button to Change network settings.
7. Instructions will appear telling you to save settings and reboot to put the changes into effect. To do this, click on the Save Settings link and then click OK when prompted to proceed. You will need to wait 5-10 seconds for the confirmation message to appear in your web browser and click OK again and then click on the Reboot Camera link. You can also use API functions to save settings in a telnet/serial console:

   ```
   l save_settings
   ```

   or in a web/CGI command:

   ```
   http://169.254.94.109/cgi-bin/save_settings
   ```

To reboot the camera with the new network settings, substitute `reset` for `save_settings` in the commands shown above. After 30-45 sec., the camera will complete the boot process. It will not reappear in the same browser window, since you must now enter the new camera IP address (`192.168.2.78` in this example).

2.3.6.1 Setting Your PC to a Compatible Static IP

1. On a Windows PC, go to the Windows Control Panel and double-click on the Network Connections icon.
2. Double-click on Local Area Connection. In the Local Area Connection Status window, click on the Properties button.
3. In the Local Area Connection Properties window, select Internet Protocol (TCP/IP) then click on the Properties button.
4. In the Internet Protocol (TCP/IP) Properties window, click on the option button to Use the following address. Enter an IP address that is not currently in use that is on the same subnet as the Network cameras, for example, a private

address `192.168.2.11` (or `169.254.1.1` for a link-local connection using a cross-over cable between the PC and the camera).

5. Enter a netmask value of `255.255.255.0`. You may optionally enter a gateway address such as `192.168.2.1`, but it is typically not necessary. If you are using link-local addresses for the camera and PC (e.g. `169.254.x.x`) specify the netmask as `255.255.0.0`.
6. Click OK twice, and Close to exit the 3 open windows and apply changes.

Now that the Network cameras and the PC have their IP addresses on the same subnet, the cameras will be accessible by the computer.

2.3.7 Using Apple's QuickTime

The QuickTime media player from Apple is easy to use with RTP/RTSP streaming video from the camera. To enable RTP, use the camera web interface, select Admin Mode and then the Streaming link. Check the box next to the RTP/RTSP option. The related API property is `rtp_enable`. In a Telnet/Serial console, type the following:

```
l set rtp_enable=1
```

The equivalent HTTP CGI command is:

```
http://192.168.1.222/cgi-bin/set?rtp_enable=1
```

To play in QuickTime, select File and then Open URL. Enter the URL using the following format:

```
rtsp://192.168.1.222
```

Be sure to specify the actual IP address of your camera. You may have to press the play button in QuickTime to start the streaming video.

Note: The QuickTime player does not support image widths greater than 2048.

2.3.8 Using VLC Media Player

The VLC media player from VideoLAN (www.videolan.org) is a streaming media application suitable for use with the Lumenera Network cameras. VLC requires camera firmware version 1.6.0.0 or greater.

In VLC Media Player, select File|Open Network Stream menu option to start a connection to the camera. Select the Network tab, choose the HTTP option. If your camera uses the DHCP fallback IP address of `192.168.1.222`, for example, you would enter the following in the "URL" field:

```
http://192.168.1.222/cgi-bin/nph-video?
type=multipart/x-mixed-replace
```

To pull images from earlier in the buffer, modify this link by including the optional `start` and `archive` parameters to the `video` command in the API. The value of `archive` must be `true` (`1`) for the `start` parameter to take effect. Use a

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negative value for `start` to specify how many frames back in the ring buffer you wish to begin the MJPEG video stream. This option will only work if all of the images requested are present in the buffer. A CGI example is provided below:

```
http://192.168.1.222/cgi-bin/nph-video?
type=multipart/x-mixed-replace&
start=-100&archive=1
```

If you want to record, in the same Open dialog box, on the Network tab, look at the Advanced Options area at the bottom. Check the Stream/Save check box and then hit the Settings button. The Stream Output dialog box is displayed. In the Output section, check Play locally if you wish to view live images while you record. Also check File and Browse to the correct directory and then enter a file name including the extension, e.g. newclip.asf or newclip.mov.

To create a file for later play back in Windows Media Player, you can use the following options:

- Encapsulation Method - ASF (Windows Media standard)
- Transcoding options - check Video codec, select DIV3 from pull-down, select bit rate 1024 (default) from the pull-down menu.

Once you exit the dialogs and click on the play button, the camera's video stream will be recorded to the .ASF file name provided.

To create a file for later play back in QuickTime, you can use the following:

- Encapsulation Method – MOV
- Transcoding options - check Video codec, select DIV3 from pull-down, select bit rate 1024 (default) from pull-down.

Note: One potential issue with VLC is that if you go back and edit the file name in VLC, it will not take effect. So it is recommended to use a single file name and keep overwriting it, as long as you are sure to rename the specific ASF or MOV files using Windows Explorer when you want to keep them.

VideoLAN provides an ActiveX control that can be incorporated into your custom applications. Feel free to contact VideoLAN for more information on this ActiveX control and to acquire it at www.videolan.org for details.

2.3.9 Using Mozilla Firefox or Konqueror web browsers

Some web browsers such as Mozilla Firefox and Konqueror offer support for MJPEG streaming and display. This feature is not present in Internet Explorer. To use this feature, simply enter a URL in the address line of the web browser. The format of the URL is the same as that describe in Section 2.3.8

2.4 Troubleshooting Camera Connections

The LeCam Client application from the installation CD-ROM will locate local Network cameras, allow you to view images from them and open their web interfaces. Below is a quick list of steps that will help you communicate with your cameras more easily:

1. Verify that the camera is powered on and is connected to the network cable. A green link light on the Ethernet port indicates an active network connection. Verify that your computer and the camera are physically connected to the same network switch or router.
2. Open the LeCam Client application to find your camera on the network. If it is not presented in the list of available cameras, you may need to modify your Network properties to see it from this network. Chapter 3 provides more information on how to find and use the LeCam Client application with your Network camera.
3. Ping the camera. This will check to see that your computer can communicate to the camera over your network. On a Windows PC, go to the Start menu, select Run… and enter `cmd` in the Run dialog. This opens a Command Prompt window with a command prompt such as:

   ```
   C:\Documents and Settings\user>
   ```

   At the prompt, type `ping` followed by the camera IP address and press the enter key:

   ```
   ping 192.168.1.222
   ```

   The ping command will attempt to communicate with the specified IP address to a total of four attempts, and provide a report each time. A communication failure is indicated by the response:

   ```
   Request timed out.
   ```

   Successful communications create a response of the format:

   ```
   Reply from 192.168.1.222: bytes=32 time=1ms TTL=63.
   ```

4. Check that the PC's IP address is compatible with that of the camera. To check a Windows PC's IP address, go to Network Connections, right-click on the Local Area Connection and select the Properties menu option. The LAN Properties dialog will display a list below the text "This connection uses the following items:" The option Internet Protocol (TCP/IP) is normally displayed near the bottom of the list. Select the Internet Protocol (TCP/IP) item and click on the Properties button. To provide a route to the camera, the TCP/IP properties of your PC should be similar to the camera's Network settings. Ensure that the computer IP address is on the same subnet as the Network camera's IP address (e.g. both camera and PC have `192.168.22.xxx` IP address with netmask `255.255.255.0`). Refer to Sections 2.3.6 and 2.3.6.1 for details of the camera's Network menu.

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5. Reset your Network Interface Card. For a Windows PC, go to the Start Menu, Control Panel. Double-click Network Connections, then right-click on Local Area Connection. Select either Repair or Disable menu options. Right click and select Enable menu option after using the Disable option. This should fix most common network problems, such as an intermittent physical connection.
6. Check that the PC's IP address is compatible with that of the camera. To check a Windows PC's IP address, go to Network Connections, right-click on the Local Area Connection and select the Properties menu option. The LAN Properties dialog will display a list below the text "This connection uses the following items:" The option Internet Protocol (TCP/IP) is normally displayed near the bottom of the list. Select the Internet Protocol (TCP/IP) item and click on the Properties button. To provide a route to the camera, the TCP/IP properties of your PC should be similar to the camera's Network settings. Ensure that the computer IP address is on the same subnet as the Network camera's IP address (e.g. both camera and PC have `192.168.22.xxx` IP address with netmask `255.255.255.0`). Refer to Sections 2.3.6 and 2.3.6.1 for details of the camera's Network menu.

2.5 Firmware Upgrades

As part of our program of continuous improvement, Lumenera offers firmware upgrades that add new features to and improve the functionality of our Network cameras. This section explains how to upgrade the camera firmware using the web interface.

The firmware is provided as a compressed zipped archive file with a ".tgz" file extension. The archive name specifies the camera model, color format (color or monochrome); the day-night support (optional), a four-digit software revision code and the software build number. Released versions of the camera firmware end with an even number.

Below, demonstrates an example of a typical archive file name:

```
upgrade-le175c-dn-1.8.1.0-6128.tgz
```

where:

- `le175` is the base camera model that this archive targets
- `C` is the color format. In this case it is a color camera
- `-DN` states that is has the day-night option
- `1.8.1.0` shows that it is a final release version of the firmware
- `6128` is the software build number

2.5.1 Downloading Firmware

The latest version of all camera firmware is available for download from our website at www.lumenera.com/support/dowload.php. A password is required to download these files. It is available by contacting our TAC group at support@lumenera.com.

2.5.2 Upgrading Firmware

To upgrade the camera's firmware, follow the steps below.

Note: Firmware upgrades are only supported between sequential major versions. For example to upgrade from v.1.6 to v.1.8, you need to first upgrade from v.1.6 to v.1.7, then upgrade again from v.1.7 to v.1.8. Using the incorrect version may cause incorrect or unknown behavior in your camera, could make it unusable, and in some cases damage it.

1. Save the correct .tgz files to a known location. It is important to select the correct version. Make sure that you are using the proper firmware for you camera model, color/mono type and day-night option.
2. Locate your camera using a web browser.
3. Click on the Admin Mode tab on the camera's web interface to go to the Administrator webpage.
4. Click on the Firmware link..
5. Click on the "Browse..." button to find the location of the firmware ".tgz" file. Select the bootloader upgrade file on your computer: boot-upgrade-6131.tgz
6. Click on the "Update Firmware" button. When the update completes, click on the "Done" button.
7. Return to Admin Mode and click on the Reboot Camera link to restart your camera.
8. Upgrade again, this time selecting the main firmware package upgrade-<CameraModelHere>-1.8.1.0-6131.tgz. A number of on-screen messages will appear to show the progress of the upgrade. The upgrade process takes up to 5 minutes to complete depending on the camera model. During this time, the camera will report upgrade status information to your web browser. When the upgrade completes, the camera should automatically refresh the web browser to the main camera web page.
9. In Admin Mode, click on the Watchdog link to confirm that the Watchdog Enable and HTTP check boxes are selected. Click on the Save Settings link to store any change to this setting.Open a web browser and connect to the camera.

If your web browser does not get redirected to the camera's main web page, you may need to clear the web browser's cache to remove any offline content. Detailed instructions follow for both Microsoft Internet Explorer and Mozilla Firefox.

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In Internet Explorer 7:

1. Select Tools menu item.
2. Select the Delete Browsing History option.
3. Choose either the Delete Files or the Delete All option and click on the OK button

In Mozilla Firefox:

1. Select Tools|Clear Private Data menu item.
2. When the Clear Private Data pop-up window is displayed, select the Cache check box then click on the Clear Private Data Now Button.

The default image settings are often optimized between camera upgrades. To set the camera to the new optimized defaults after the upgrade, click on the Image Defaults button then click Save Settings to store the changes.

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3

Using LeCam Client

3.1 Description and Usage

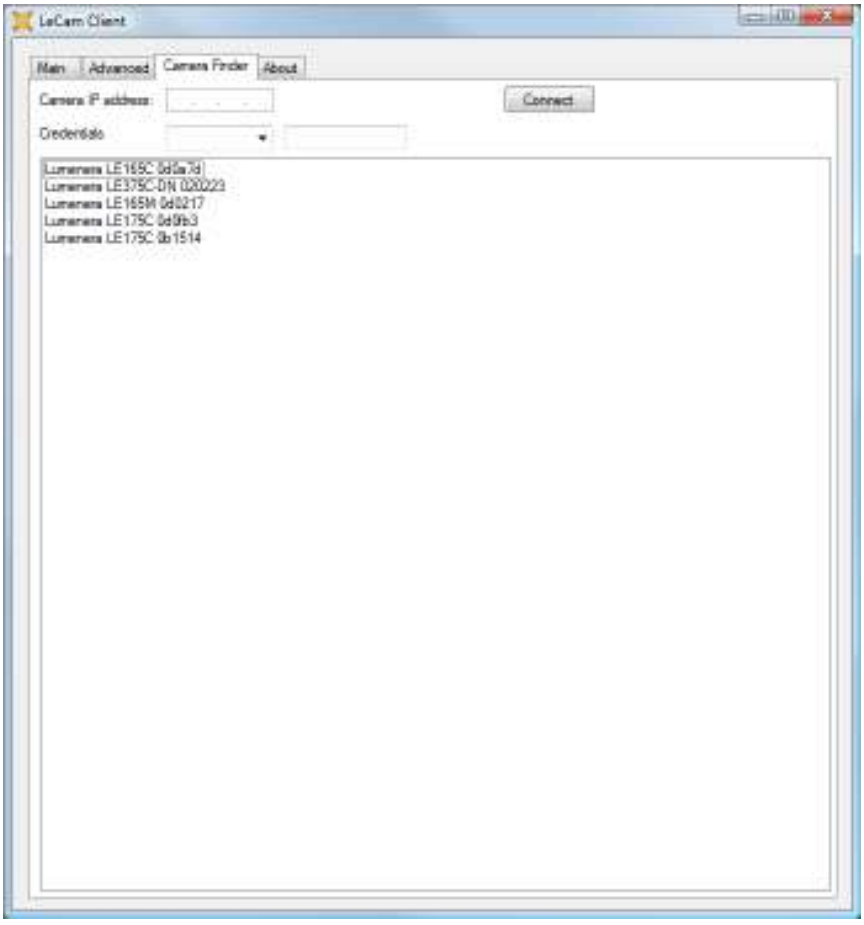

Figure 3-1 LeCam Client's Camera Finder Window

The LeCam Client application allows you to find any Lumenera Network camera that is on the same sub-net as the computer running it. It is based on the ZeroConf protocol similar to Apple's Bonjour application. To correctly install the LeCam Client application, your computer must have two prerequisites installed:

- Microsoft .NET 2.0 framework
- Apple Bonjour for Windows

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The prerequisites are included on the CD-ROM provided with your camera. They will be detected automatically if present. If not present, you will be prompted to install them. Alternatively, the prerequisites may be downloaded from the following sources.

.NET framework

http://www.microsoft.com/downloads/details.aspx?FamilyID=0856EACB-4362-4B0D-8EDD-AAB15C5E04F5&displaylang=en

Bonjour

http://www.apple.com/bonjour (Browse for Bonjour for Windows)

http://www.apple.com/downloads/macosx/apple/windows/bonjourforwindows.html

The LeCam Client application is a Windows 32-bit application.

3.1.1 Camera Finder Tab

Figure 3-1 shows the Camera Finder tab of this application. This tab shows all cameras that are accessible and responding to ZeroConf requests from the application. This list shows all the accessible cameras on your network.

To select a camera, either double-click on the entry in the list, or enter in its IP address or single-click the entry and hit the Connect button. The application will connect to the desired network camera and automatically switch to the Main tab.

This tab also provides the ability to access a camera that has user or administrator accounts enabled and configured. To access these types of cameras, you need to enter in the account credentials by following these steps:

1. Select either the admin or user account from the drop-down menu.
2. Type in the password associated with this account in the edit box beside the drop-down menu.
3. Select the camera you wish to connect to by either:
    a. Double-clicking it in the list
    b. Single-clicking it in the list and hitting the Connect button
    c. Manually entering its IP address and hitting the Connect button

The provided credentials will be used on all subsequent calls to the camera.

Note: It is not necessary to enable the admin or user account on the camera. By default, the camera does not have these accounts enabled. If your camera does not have either of these accounts enabled, leave the password field empty.

3.1.2 Main Tab

The Main tab, shown in Figure 3-2 allows you to see a preview from the camera, scroll around the camera's image window using your mouse or the arrow buttons, zoom in and out of the preview and adjust the brightness and white balance. It also allows you to capture individual images that can then be saved in a file.

This tab provides the following controls and displays:

- A thumbnail view of viewable area seen by the camera
- A size adjustable preview window
- Arrow buttons that allow you to pan around the camera's field of view.
- Drop-down zoom control menu
- A button to save the current camera settings to non-volatile memory
- Buttons to adjust the image brightness
- A button to adjust the color balance of the image
- A button to capture a single image from the camera and display it into another window, where it can be saved to a file.

The thumbnail view has a red rectangle that shows the portion of the full camera image that is displayed in the preview window. The position of this rectangle can be changed with the mouse or by the arrow buttons. The size of this rectangle is dictated by the size of the preview window and the current zoom level.

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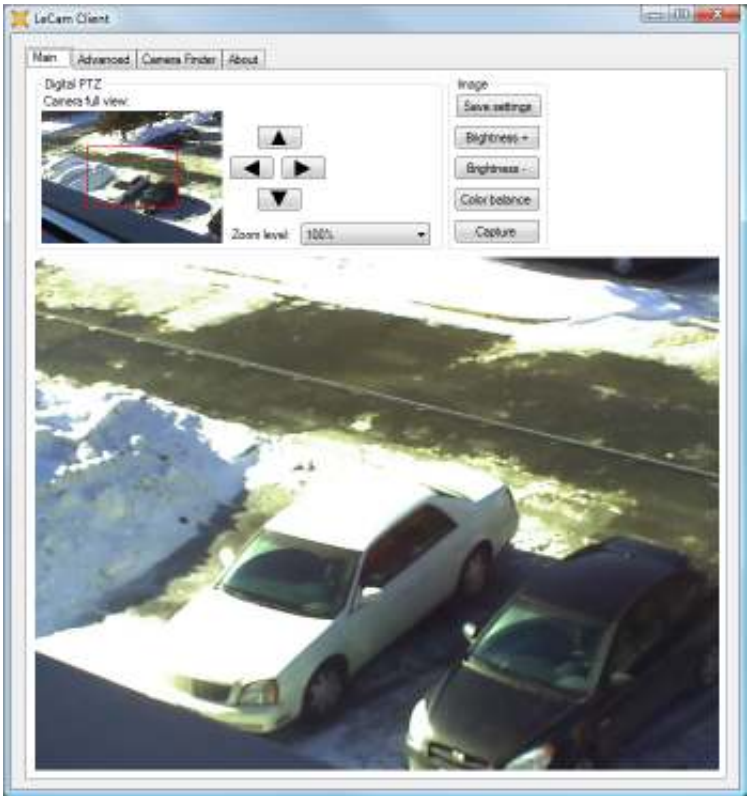

Figure 3-2 LeCam Client Main Tab

The preview window size can be changed by changing the size of the LeCam Client application's window size. You can move the mouse to the edges or the corners of the window and resize it. As the application's window changes in size, the preview adjusts itself accordingly. You can also click on the maximize button on the title bar to maximize the window. Click on the minimize button on the title bar to hide the window from view. You can also pan around the camera's field of view by clicking and holding down the left mouse button and "dragging" the image in the direction you want to view.

The Save settings button saves all the current camera settings to non-volatile memory, overwriting the default boot up settings. On the next reboot of the camera, these saved settings will be restored.

The Brightness buttons change the camera's luminance target value used for the auto-exposure, auto-gain and auto-iris algorithms. This will cause the image intensity to either increase or decrease to achieve the new target intensity.

Note: In low light conditions, the target intensity may not be reachable so increasing the brightness may not have any effect on the image intensity.

The Color balance button adjusts the camera's color gains to make the white parts of the image purer.

The Capture button captures a single full view image from the camera and places it inside another window, as shown in Figure 3-3. In the Capture window, you can

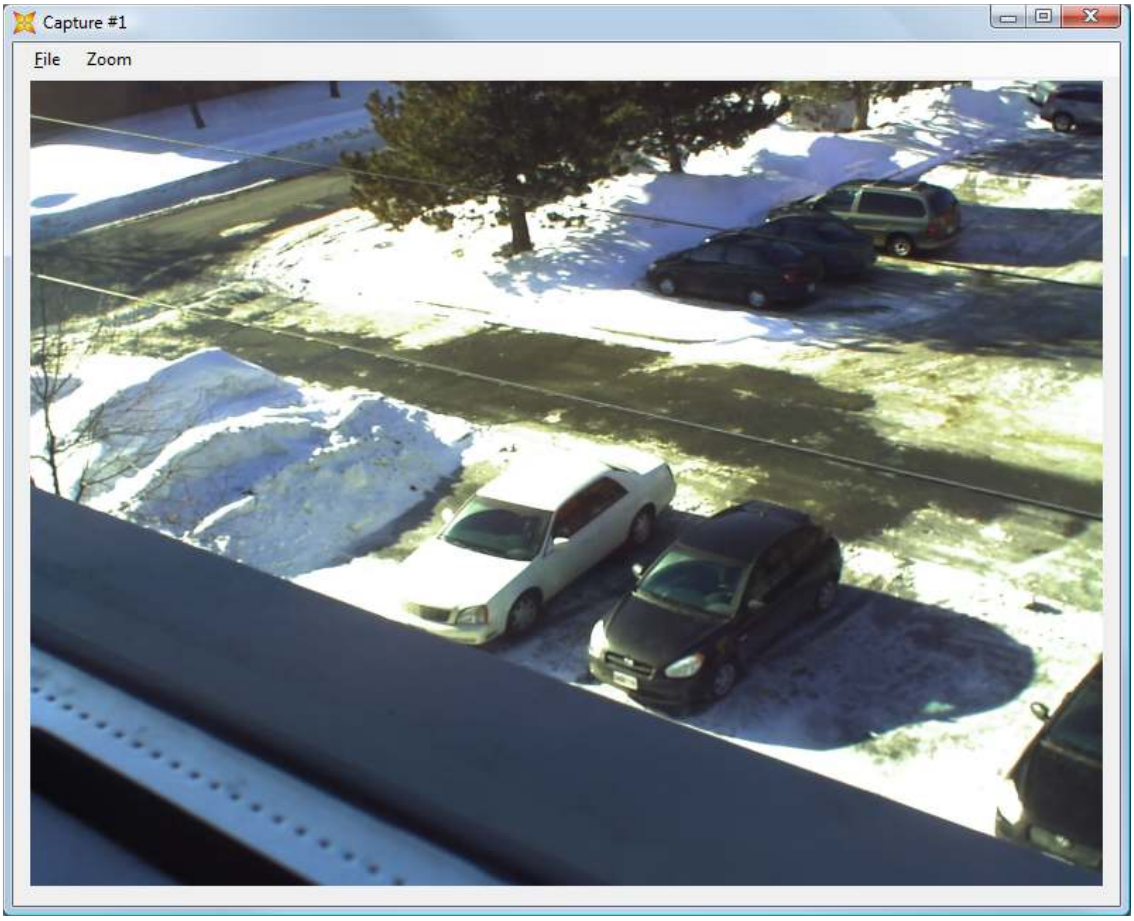

Figure 3-3 LeCam Client Capture Window

resize the image by resizing the window, zoom in or out of the image through the Zoom menu or save the image to a file through the File menu.

3.1.3 Advanced Tab

The Advanced tab provides a thumbnail view of the current image and provides a web link to access the camera's web interface. It will open up the default web browser and automatically connect to the camera. This interface allows you to access additional features and properties of the camera that may not be controlled directly by the LeCam Client application.

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4

Understanding Your Camera

4.1 Shutter Types

The images produced by your camera are affected by the speed of moving objects in relation to the camera, the ambient light level, and other factors. Understanding the shutter types used by the different cameras is important in getting the best images possible from your camera.

Depending on which camera model you have, the following electronic shutter types may or may not be present. Check the table below to determine which camera model has which shutter type.

Table 4-1 Shutter Types by Camera Model

Camera Model	Rolling Shutter	Global Shutter
Le045 Li045	No	Yes
Le075	No	Yes
Le165 Li165	No	Yes
Le175 Li175	Yes	No
Le259	No	Yes
Le275	Yes	No
Le375	Yes	No
Le575	Yes	No
Le11059	No	Yes

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4.1.1 Rolling Shutter

With a rolling shutter the exposure process begins, whereby, rows of pixels in the image sensor start exposing in sequence, starting at the top of the image and proceeding row by row down to the bottom. At some later point in time, the readout process begins, whereby, rows of pixels are read out in sequence, starting at the top of the image and proceeding row by row down to the bottom in exactly the same manner and at the same speed as the exposure process.

The time delay between a row starting to expose and a row being read out is the integration time, also known as the exposure time. This integration time can be varied from a single line (start exposure followed by a read out while the next line is exposing) up to a full frame time (last line starts exposing at the bottom of the image before reading starts at the top). In some cases, longer exposures can be obtained by delaying the read out even longer (during which time, the entire array is exposing).

Since the integration process moves through the image over some length of time, skewing of moving objects may become apparent. For example, if a vehicle is moving through the image during capture, light from the top of the vehicle will be integrated at some earlier time than light from the bottom of the vehicle, causing the bottom of the vehicle to appear slanted forward in the direction of motion. For most slow moving objects or still image capture, this motion artifact is not noticeable.

4.1.2 Global Shutter

With a global shutter, the entire image array starts exposing at the same time (globally). At some later point in time, the entire image array stops exposing at the same time and the image is read out in sequence, starting at the top of the image and proceeding row by row down to the bottom (sometimes odd rows are read out first followed by the even rows). The difference from the other modes is that during readout, the imager is no longer integrating light.

The time delay between the start of exposure and end of exposure is defined as the exposure time and it represents the total amount of time that the image integrates.

Because all the pixels start exposure at the same time, integrate over the same interval, and stop exposing at the same time, the potential for motion artifacts is reduced compared with cameras with rolling shutters.

4.2 Subwindowing, Subsampling & Binning

Subwindowing, also known as region of interest (ROI), is the ability to select a reduced image size within the whole imager array. The inherent resolution of the image sensor is retained, but the frame rate can be increased due to the reduced image size. The Le175 camera, for example, can output a subwindow of 640x480 pixels positioned nearly anywhere inside the original 1280x1024 field of

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view. The subwindow provides a smaller partial field of view. There are limitations on the granularity of the subwindow size and position (8 pixels for Network cameras).

Subsampling, also known as decimation, involves discarding every n^{th} pixel or pixel pair in the image. Subsampling involves a trade-off of lower image quality (resolution) in favor of higher frame rate. For example, the Le175 camera with maximum resolution of 1280x1024 pixels can discard every second pixel in both the X and Y directions and output an image composed of 640x512 pixels. The subsampled image still covers the entire available field of view. Not all Lumenera Network cameras support subsampling. Those that do support subsampling levels of 2, 4 or 8. Subsampling is a feature of CMOS active pixel image sensors.

Binning is a feature of CCD image sensors that reduces resolution in a manner similar to subsampling with the key distinction that the signal charge in neighboring pixels is combined rather than discarded. The resulting resolution would be the same as for subsampling, and the frame rate is also increased, but no analog signal is lost in the process. One of the implications for binning on a color image sensor, that uses mosaic pattern filters on the pixel array, is that the color information is lost when binning the signal in adjacent pixels.

Both binning and subsampling use the API property `subsampled`, with the values indicated in the table below.

Table 4-2 Subsampling and Binning Modes

Models	Supported modes	subsampled value
Le/Li045	Feature not supported	0
Le075 Le165 / Li165* Le259* Le11059*	Native resolution	0
	Binned 2 X 2	1
	Binned 4 X 4	3
	Binned 8 X 8	7
Le175 / Li175* Le275 Le375 Le575*	Native resolution	0
	Decimate 2 X 2	1
	Decimate 4 X 4	2
	Decimate 8 X 8	3

*Not all subsampled modes are available on these models in the current versions of the firmware.

4.3 Camera Mode: streaming video (MJPEG)

The Lumenera Network cameras operate only in continuous capture mode. There is no capability for acquiring triggered snapshots. Image frames are continually being captured, JPEG compressed, and stored in a rolling memory buffer. When requested, the data is transmitted to each user over the Ethernet

connection. Where multiple users access the camera simultaneously or bandwidth is limited, some frames may be dropped.

There are two primary factors that affect the image quality of the cameras:

- The camera's auto-exposure algorithm can cause issues that may decrease the quality of the images produced. When the camera's gain value is increased due to low light conditions, the noise present in the images is also increased resulting in poorer image quality. Also, the exposure value may be increased to help in low light conditions. The extended exposure time produces a longer acquisition time and reduces the frame rate.
- The camera uses a JPEG compression algorithm to compress the images transferred over the network. The compression used in JPEG images is a lossy compression, meaning that some image information is lost during compression. Depending on the compression ratio used, you may see a variation in the image quality. Higher compression ratios will increase the loss of image information in the final JPEG image file.

The maximum network capacity required for the Network camera is 1.5MB/s using HTTP for Le-series cameras. For the Li-series cameras and the Le045 model, the throughput is up to 5 MB/s if required. The MJPEG streaming video from the camera maintains a constant bandwidth without burst traffic. The frame rate performance diminishes with network congestion.

4.4 Scanning Mode

Most Lumenera Network cameras operate in progressive scan mode. In a progressive scan camera, the entire image is integrated (exposed) at one point in time (for global shutters) or line-by-line from top to bottom (for rolling shutters).

4.5 Auto-Brightness Control (ABC)

The camera will adjust the iris, exposure and gain so as to ensure that the image brightness is maintained. The way in which the camera adjusts these settings is based on a predefined algorithm. Below is a simplified description of how the camera adjusts these settings based on the changing lighting conditions.

Ambient light is getting darker:

1. The camera will first try to adjust the DC iris to allow more light to enter into the camera and be seen by the camera's sensor.
2. When the DC iris is open completely, the camera will start to increase the exposure value to the first knee point.

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3. When the exposure knee point is reached, the camera will adjust the global gain to its first knee point.
4. The camera will further increase the exposure and then the gain until the maximum exposure and gain values are reached.

Ambient light is getting brighter:

1. The camera will decrease the global gain value until it reaches the first knee point.
2. The camera will decrease the exposure until it reaches the first knee point.
3. The camera will further decrease the gain and then the exposure until both these parameters are at their minimum values.
4. Once the exposure and gain values are at their minimum values, the camera closes the DC iris to minimize the amount of light seen by the sensor until the iris is closed.

The Lumenera website provides an Application Note that describes further how the Auto Brightness Control (ABC) works on Lumenera Network cameras.

4.6 Locking Connector for External Power and I/O

The 10-terminal locking connector plugs into a socket on the rear of the camera (item 2 in Figure 2-1, Figure 2-2, or Figure 2-3). The connector is keyed to fit in only one orientation. For large-format cameras, the top-to-bottom orientation of the connector is rotated by 180-degrees in the usual upright camera mounting position.

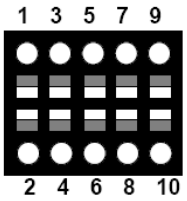


Figure 4-1 Diagram of the 10-Pin Locking Power Connector

Table 4-3 Detailed Pin-Out of Locking Power, I/O & Rs232 Connector

Le series Cameras (DC iris for legacy cameras only)

1	3	5	7	9
DC Iris Drive + (Yellow)	DC Iris Control + (Red)	Trigger In +	Alarm Out +	Power +
DC Iris Drive - (Orange)	DC Iris Control - (Brown)	Trigger In –	Alarm Out –	Power -
2	4	6	8	10

Li series and Le045 Cameras

1	3	5	7	9
RS232 RX	Not used	Trigger In +	Alarm Out +	Power +
RS232 TX	Not used	Trigger In –	Alarm Out –	Power -
2	4	6	8	10

To open the lock and insert a wire, use a small flat-head screwdriver to push the metal lock in. Remove the screwdriver from the lock to secure the wire. The wire gauge must be AWG 18 to AWG 28.

The locking connector provides terminals 9 (Power +) and 10 (Power-) to supply power to the camera where PoE is not used. Be sure to observe the power requirements listed for each model referring to Table 2-2, Table 2-3, and Table 2-4 in Section 2.1. The recommended universal power supplies are:

- Lumenera part Lu8501 (12 VDC) for all Le-series cameras.
- Lumenera part Lu8401 (24 VDC) for all intelligent (Li-series) cameras.

Note: Be sure to apply the correct polarity.

Note: Do not ground-reference either terminal of the AC power supply (optional for Li175) as you may permanently damage the camera.

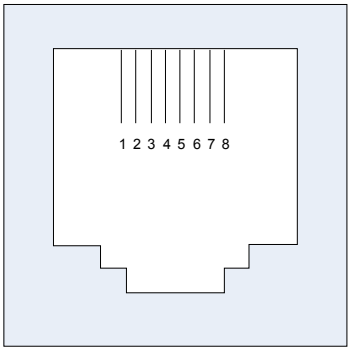
For legacy Le-series cameras without an integrated DC-iris socket, use Lumenera's Le902 DC-iris adapter. See Section 5.4 for details.

Please refer to Section 5.7 for details of interfacing to the general purpose input and output (GPIO) terminals.

4.7 RJ-45 Ethernet Jack

The Ethernet cable connection on the Network camera uses a standard RJ45 connector and is shown in Figure 4-2. The pin out of this connector is standard for 10BASE-T and 100BASE-TX configurations.

Lumenera Power over Ethernet (PoE) capable cameras comply with the IEEE 802.3af standard. Lumenera cameras will automatically draw power from PoE using either Mode A or Mode B. Mode A supplies power as a DC bias on the data signaling pairs: pair 1/2 and pair 3/6. Mode B supplies power to pair 4/5 and pair 7/8.



Position 1	Tx +
Position 2	Tx –
Position 3	Rx +
Position 4	Not used
Position 5	Not used
Position 6	Rx-
Position 7	Not used
Position 8	Not used

Figure 4-2 RJ45 Connector Pin out

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4.8 Lens Mount

4.8.1 Small Format and Intelligent Cameras

These Network cameras are equipped with an industry standard CS-Mount lens mount with adjustable back focus. A 5mm spacer (Lumenera part Lu901) can be added to the lens mount to accommodate C-Mount lenses.

4.8.2 Large Format Cameras

Large format cameras are equipped to support off-the-shelf 35-mm SLR lenses. The standard format supported is the Canon EF mount. Contact securitysales@lumenera.com to inquire about support for other 35-mm lens formats.

4.9 Analog Video Output

Figure 4-3 Web Browser Option to Enable/Disable the Analog Output

For Li-series cameras, the BNC connector on the camera back panel (item 3 in Figure 2-3) provides a composite video output. NTSC is the default factory-set format. The analog video output is especially useful for CCTV installers during the initial setup of the camera and lens when using a CRT monitor to verify the camera alignment and focus are correct.

Note: After installation, in order to maximize the efficiency of the IP camera, the system administrator can disable the analog output.

The analog video output can be disabled by clearing the Analog video output on/off checkbox found in the web browser user interface under the Streaming web link of the Admin Mode tab (see Section 6.8 for more details). The API property to set to disable the analog output is:

`frame_buffer_enable`=0

The composite video format is normally set at the factory to NTSC. To change the video format to PAL, enter the following in a Telnet session to the camera:

`l set video_mode`=pal.

Since the change to PAL format involves a change in the boot configuration of the camera, you must save settings and reboot the camera to apply the change.

4.10 Audio Functions

For the Li-series cameras and the Le045, a single audio input/output jack is located on the back panel (see item 5 in Figure 2-3). The audio input/output jack will accept a 3.5mm stereo plug. The connection is non-standard in the sense that one mono audio input and one mono audio output share a single stereo plug.

Table 4-4 Mic In Audio Specifications

Specification	Value
Absolute max. input	3.6 V
Recommended max. input	0.707 VRMS
Input resistance	80 kOhm
Bias voltage	2.5V typ. (programmable)
Bias current source	4 mA @ 2.5V

Table 4-5 Line Out Audio Specifications

Specification	Value
Recommended load	10 kOhm
Full-scale output voltage	2.0 VPP 0.707 VRMS @ 0-dB gain (programmable)

Table 4-6 Configuration of 3.5 mm Stereo Plug

Conductor	Function
Connector format	3.5 mm stereo plug
Tip	MIC IN
Ring	LINE OUT
Sleeve	GROUND

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4.11 Factory Reset

Several methods are available to revert to saved/default settings on the Network camera. This includes both a reset switch and software commands.

Note: By restoring the factory default settings, the camera's network settings are set to contact a DHCP server to acquire a dynamic IP address. The camera IP address may change after the reset is complete. If no DHCP server is present, the camera may be found using the fallback IP address (`192.168.1.222`) or the link-local IP (described in more detail in Section 2.3.5).

4.11.1 Factory Reset Switch

On Le-series cameras (excluding the Le045) there is a recessed reset switch on the camera near the RJ45 port that can be used to perform a hardware reset to factory defaults. The reset sequence using the reset switch is as follows:

1. Turn off the camera by disconnecting the power cable.
2. Locate the small hole next to the serial port on the back of the camera.
3. Insert a pin or paperclip into the hole to depress the Factory Reset button. The button clicks when it is pressed down.
4. While holding down the Factory Reset button, restore power to the camera by connecting the power cable. Continue holding down the Factory Reset button until the orange boot LED on the Ethernet connector blinks rapidly (approximately 30 seconds).

4.11.2 Software Reset & Recovery Commands

4.11.2.1 Reset defaults using the Web User Interface.

For the commands below, substitute `192.168.1.222` with your actual camera IP address.

To set default settings for image parameters only, click on the Image Settings link in Admin Mode.

To revert to your power-on settings without power cycling, click on the Load Settings link in Admin Mode or enter:

```
http://192.168.1.222/cgi-bin/load_settings
```

To reboot the camera, click on Reboot Camera in Admin Mode, or enter:

```
http://192.168.1.222/cgi-bin/reset
```

To revert to factory settings, enter the following. Network settings will not be changed until you save settings and reboot.

```
http://192.168.1.222/cgi-bin/
load_settings?filename=factory_defaults
```

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To reboot and revert to factory settings (same as hardware reset to factory defaults using button on rear of the camera), enter:

```
http://192.168.1.222/cgi-bin/nph-reset-factory-
defaults.sh
```

4.11.2.2 Reset defaults using a Telnet or Serial Port Connection

Refer to Sections 5.7 and 5.8 for information on telnet and serial consoles. The syntax for entering console commands is the same when using either a telnet interface or the camera's RS-232 serial interface.

To revert to your power-on settings without power cycling, enter:

```
l load_settings
```

To load defaults for image settings only, enter:

```
l put_settings_from_property default_image_params
```

To reboot the camera, enter the following:

```
l reset
```

To revert to factory settings (same as hardware reset switch) enter:

```
l nph-reset-factory-defaults.sh
```


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5

Configuring and Using Your Network Camera

5.1 Video Management Support

Lumenera has partnered with several third-party Video Management providers and companies. Our partners include Network Video Recorder (NVR) application software providers and manufacturers of Digital Video Recorder (DVR) hardware. Both types of video management systems include software that allows a system administrator to configure multiple networked cameras and provide functions for video previewing, recording and playback, and also provide archive management. These applications also allow configurable recording schedules either based on a timed event or on an alarm/motion event.

The Lumenera website includes an up-to-date list of our Video Management Partners:

http://www.lumenera.com/security

Please refer to each partner website for more information on their respective applications or to download evaluation/demo versions of their software.

5.2 Mounting the Camera

The camera provides a standard ¼"-20 tripod mount. This mount can be used with any tripod or other mount that uses this screw type.

For small-format cameras, the mount can be moved from the bottom to the top of the case by loosening the 4 nylon screws using a small screwdriver. Use caution to avoid damaging or breaking the nylon screws.

Contact securitysales@lumenera.com for our latest accessories list, including weatherproof enclosures and mounting brackets.

For lab or bench top use, use mounting hardware from opto-mechanical suppliers such as Thorlabs, Newport, Melles Griot and others.

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5.3 Lens Selection

The Network camera provides a CS-mount lens mount as a standard feature in small format models. A C-to-CS mount adapter, Lumenera part number Lu901, can be added to the mount to accommodate a C-mount lens. Be sure to select the optical format (size) appropriate to your camera. Select a lens with an optical format equal to or larger than that of the camera's sensor.

Large-format models use Canon EF-mount 35-mm SLR lenses.

Table 5-1 Optical Format for Each Camera Model

Camera	Optical format
Le045 / Li045	1/3 inch
Le075	1/3 inch
Le165 / Li165	2/3 inch
Le175 / Li175	1/2 inch
Le259	35 mm
Le275	1/2 inch
Le375	1/2 inch
Le575	1/2.5 inch (uses 1/2" lens)
Le11059	35 mm

It is important to select megapixel lenses for use with megapixel cameras. Many conventional, low-cost, low-performance lenses designed for low-resolution CCTV cameras are not suitable as they cannot resolve images properly on sensors with small pixel pitch as those used in megapixel lenses. These lenses may cause aberrations or other imaging artifacts in the video feed that may be undesirable.

There are a few lens features to consider when purchasing lenses for your camera:

- Be sure to look for lenses that specifically state that they are megapixel lenses.
- Vari-focal lenses can be more difficult to adjust for megapixel cameras than with low-resolution cameras. Since in most camera installations, the field of view will be constant, you may want to consider a fixed focus lens.

Lumenera provides a limited selection of lenses that are suitable for your camera. Feel free to contact us at support@lumenera.com or securitysales@lumenera.com for more information on selecting a lens that is suitable for your application.

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5.4 Using DC auto-iris lenses

The Lumenera Network cameras support connecting and controlling 4-wire DC auto-iris lenses. Auto-iris lenses have the capability to vary the lens aperture. In low-light situations, the iris opens to improve the light gathering ability of the camera. In bright conditions such as direct sunlight, the iris closes, reducing glare and increasing the depth of focus. This section explains how you can connect and configure the camera to use DC auto-iris lenses.

Note: Lumenera Network cameras only support DC-iris lenses (also called galvanometric or direct-drive). Video auto-iris lenses that control the iris based on the composite video output of an analog video camera are not supported.

5.4.1 Connecting the DC-Iris Lens

Most Lumenera cameras come with an integrated, industry-standard 4-conductor DC-iris socket.

For older Le-series cameras, use the Le902 DC-iris adapter to connect a DC-iris lens. The Le902 DC-iris adapter provides a miniature socket for 4-wire DC-iris lenses wired onto the 10-position plug on the Network cameras. This part can be purchased directly from Lumenera or through your local Sales representative. Manually stripping and connecting the wires within the DC-iris lens control cable is not recommended due to the fine gauge wires used. However, one can manually wire the DC-iris lens directly into the 10-position socket of the Le series Network cameras. Table 4-3 in Section 4.6 provides a detailed description of the 10-position socket.

5.4.2 Configuring Camera to Use DC-Iris Lens

To configure the camera to use the features of the DC-iris lens:

1. Open a web browser and load the camera's main web page.
2. On the main webpage, select Admin Mode tab.
3. Select the Exposure/Gain link
4. Select the AutoIris check box.
5. (Optional) Specify the minimum exposure.
6. Select the Save Settings link to store your settings changes to the non-volatile memory.

The camera normally combines automatic gain and exposure control with DC-iris control to maintain the desired target brightness of the image. The minimum exposure defines the exposure time at which the camera switches over to DC-iris control from auto-exposure control (default: 6 ms). Enter a value of zero for the minimum exposure to defer DC-iris operation until the camera applies the shortest possible electronic exposure control time.

You can also configure the DC-iris using the following API parameters.

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```
autoiris=1
minimum_exposure=<your minimum exposure value>
```

5.5 Input/Output and Synchronization with External Events

The camera is equipped with general purpose input/output (GPIO) terminals on the 10-position socket on the rear of the camera. The GPIO terminals connect to opto-isolators to help prevent accidental damage to the camera hardware.

5.5.1 General-Purpose Input

A hardware GPIO input is available that allows triggering alarm behaviors such as FTP transfer of images (`alarm_enable_ftp` API property). The synchronization is limited to approximately one frame period. To enable the hardware input, go to the Alarms link on the Admin Mode tab, and select the "IO IN Alarm Enable" option, or use the `io_in_alarm_enable` API property. In addition to FTP image transfer, other alarm responses include sending an email notification and or a UDP alarm message packet.

The camera has an `alarm_delay` property to limit the number of alarms received in a short time interval by specifying the delay in seconds to wait between alarm events. The factory default for the delay between alarms is 60 seconds (1 minute). You can alter the delay in the Alarms page on the Admin Mode tab by entering a value greater than zero in the Delay Between Alarms field. The alarms page also has options to select edge triggering (looks a the transition point where the digital signal changes from one voltage to the other, e.g. going from a digital 0 voltage to a digital 1 voltage) between instead of level triggering (looks at the voltage level of the signal), and to trigger on a negative level (when the voltage is 0V DC) or falling edge (when the signal is transitioning from a digital 1 voltage to a digital 0 voltage). Refer to Section 6.7 for details.

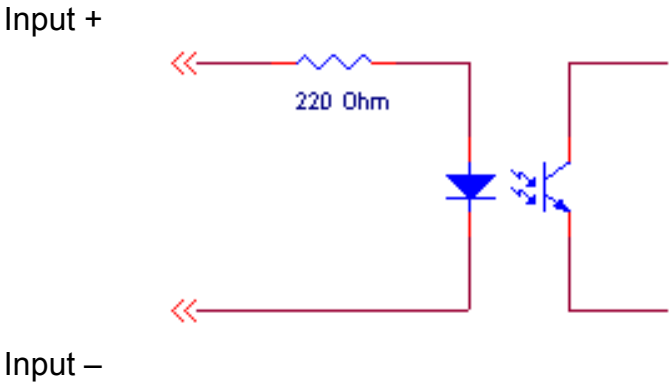

Figure 5-1 Input (GPI) Circuit

The GPI opto-isolator circuit consists of a photo-transistor and a 220 Ω resistor. A minimum current through the circuit is required to generate an alarm event. The circuit is designed to work with a 5 V input without any other external

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components. For higher voltages an external resistor or other limiting device must be used to limit the current.

Table 5-2 Input (GPI) Opto-Isolator Parameters

Specification	Value	
Minimum current	10	mA
Maximum current	30	mA
Diode forward voltage drop (typical)	1.2	V
Reverse current, maximum, at Vr = 4V	10	µA
Reverse voltage, maximum allowed	5	V
Maximum voltage on either pin	30	V

5.5.2 General-purpose output

A hardware GPIO output is also available. This has several modes that can be specified by selecting the Alarms link on the Admin Mode tab and selecting the Output Select options listed under the heading DC Output. Each mode defines a setting of the `output_select` API property as shown in the table below.

Table 5-3 General Purpose Output Modes Set Using `output_select`

Value of output_select	GPO behavior	Comments
off	Off (disabled)	For all models.
on	On (enabled)	For all models.
alarm	Pulse upon alarm	Responds to either general-purpose input or motion detection alarm
strobe	Pulse when exposure is valid for each frame	Use with Le075. Le/Li165, Le259, or Le11059 global-shutter cameras to expose the image using a flash.
start_of_readout	Pulse when line 1 of the image begins readout.	Similar to "strobe" for rolling-shutter models. Line 1 is not exposed by the flash.

To test the functioning of the general purpose output, use the `strobe` API function to send a single pulse with duration in milliseconds set by the API property `strobe_length` (default is `strobe_length=10 ms`).

Using a web browser:

```
http://192.168.1.222/cgi-bin/strobe
```

Using a telnet or serial console:

```
l strobe
```

The output opto-isolator terminals connect to the collector and emitter of a photo-transistor. When the output is active, the transistor will conduct current from the collector to the emitter.

The output can be used to control external sensors and light sources. The sensor may be a logic gate or the base of a higher power transistor for an external device that is to be activated due to a motion alarm or input alarm, with the camera setting of `output_select=alarm`. When working with external light sources, the output can be connected to the trigger input of a strobe lamp or LED

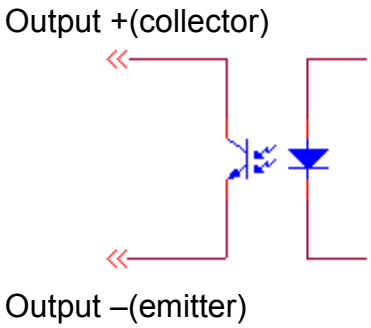

Figure 5-2 Output (GPO) Circuit

illuminator to synchronize the flash with the camera exposure time, using the `output_select` setting `strobe` or `start_of_readout`.

An external bias voltage across the output terminals is needed to generate a proper signal. Typically, the collector is tied to a voltage source and the emitter is grounded. One pin should be connected to a pull-up or pull-down resistor to limit the current.

Table 5-4 Output (GPO) Opto-Isolator Parameters

Specification	Value	
Collector current, maximum	40	mA
Collector-emitter voltage, maximum	50	V
Emitter-collector voltage, maximum	5	V

5.6 Use of Flash or Strobe

A flash or strobe may be used with any camera model and the option is available to provide a programmable trigger signal from the camera to the flash or strobe device to tell it when to fire. However, the type of shutter mode being used will dictate what conditions will be required and how well flash photography will work with the camera.

5.6.1 Flash with Global Shutter

The use of a flash or strobe with a global shutter has no limitations or concerns. The strobe signal from the camera is generated at a user selectable delay from the start of the exposure. Very short, global exposures can be used, so, there will be no blurring, skewing or overexposure due to long exposures. Also, the lens iris can be used to help limit the amount of light that reaches the sensor which can be helpful to increase the depth of focus of the captured images.

5.6.2 Flash with Rolling Shutter

The use of a flash with rolling shutter is only feasible for cameras that allow exposures longer than frame readout time (typically ~30 ms). This is because with exposures less than that, only a band across the imager is being exposed at a given point in time when the flash fires. As a result, it will only illuminate that

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region of the imager. Longer exposures are required when using rolling shutter imagers since the flash must be fired at a time when all the pixels of the imager are simultaneously exposed to light.

The flash trigger to be used with rolling shutter cameras is through the setting of the `output_select=start_of_readout` mode. The `start_of_readout` signal from the camera is generated at the end of exposure of line 1, the top line of the image. As a result, the first line of the image will never be exposed by the flash. The exposure and readout of each row of the rolling shutter image sensor proceed sequentially, one row at a time. As a result, the bottom rows of the image will only be exposed by the flash if the exposure time exceeds the frame readout time.

Generally, the ambient lighting should be low enough (i.e. dark) so that during the overall exposure the ambient light and/or the lens iris should be almost completely closed so that the ambient light will not contribute much to the overall brightness of the image. This is particularly true if the flash is being used to stop the motion of a fast-moving object, otherwise, blurring or skewing may occur in the captured image. For imaging still objects, this is not as much of a concern. In this case, you only need to ensure that you are not overexposing the object with both a long exposure and a powerful flash. When using a flash, the duration of the flash pulse defines the exposure of the image even though the camera's exposure time is set longer.

5.7 Serial Port Configurations

The serial port can be configured as a console or to control various accessories. This section explains how to configure the serial port for both options.

5.7.1 Using the Serial Port as a Console

The factory default is to set the camera's serial port to console mode. To open a serial console session with the camera, use a terminal emulator application such as HyperTerminal or Token2. The default settings of the camera's serial interface are as follows:

```
serial_use=console (required for console access)
serial_speed=19200 (the baud rate)
serial_flow=none (the flow control method)
```

Specify the COM port in use on your PC, the baud rate, number of data bits (8), parity (none), and stop bits (1).

For example, in Token2 (http://www.choung.net/Token2Plus/) to connect using the COM2 port of your Windows PC, specify the resource as:

```
com://2,19200,8,n,1
```

When the console session is established, the camera will respond with a prompt of #. At this point, it is possible to enter API commands and queries using the

command line interface. For example, the following command returns the current firmware version information:

```
l version
```

The console can also be used to get and set camera properties:

```
l get exposure
l set autogain=1
```

5.7.2 Enabling the Serial Port for Controlling Accessories

Lumenera Network cameras can provide access to the external serial port by other Internet hosts to control accessories connected to it. This feature is known by the short name of sersock (SERial SOCKet), sometimes also called a "transparency" or "pass-through" mode.

To enable the sersock mode, set the following camera parameter, save settings, and reboot the camera.

```
serial_use=accessory
```

When the camera is booted with this option, it will relay all bytes received on port 8548 of a TCP connection to the serial port with minimal buffering and delay, and forward all bytes received back through the same connection. If no TCP connection exists, all received bytes are ignored.

The baud rate and parity of the serial port are set by the `serial_flow`, `serial_speed` and `serial_echo` parameters. The factory defaults for these parameters are:

```
serial_flow=none
serial_speed=19200
serial_echo=1
```

Note: Currently hardware flow control is not implemented on the serial port and software flow control is not used by default. Using the serial port for accessory connections prohibits using it for a control console. If the camera is reset to its factory defaults, the serial port will revert back to console. If the accessory sends data to the camera while the camera is set to console mode then normal operation of the camera may be disrupted.

5.7.2.1 To Enable Sersock mode from a Telnet Console

A telnet console can be used to enable the camera's serial port. The following provides an example of how to setup the serial port to run at 9600 baud. Type each line below into a telnet console connected to the camera:

```
l set serial_use=accessory
l set serial_speed=9600
l save_settings
```


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```
l reset
```

5.7.2.2 To Enable Sersock mode from a Web Browser

The serial port can also be enabled with a web browser. The following provides an example of how to setup the serial port to run at 9600 baud. Type each line below individually into your web browser's web link address field:

```
http://192.168.1.222/cgi-bin/set?serial_use=accessory
http://192.168.1.222/cgi-bin/set?serial_speed=9600
http://192.168.1.222/cgi-bin/save_settings
http://192.168.1.222/cgi-bin/reset
```

5.7.3 Controlling Accessories through the Serial Port

Access to the serial port can be done through any TCP connection made to the sersock port of the camera. One way of accessing this port is through a telnet console (e.g. `telnet 192.168.2.2 8548`).

The first connection to the sersock port maintains control of it until the connection is closed. This means that though other connections to the port may appear to succeed they will not be able to transmit bytes through the serial port. Only the main connection will have access to transmit bytes through this port. All connections will receive all bytes received by the serial port.

Below are some key points to note when accessing the sersock port:

- If you are using a telnet session to access the camera, bytes will not be sent to the camera until a full line has been entered. A full line is typically indicated by a carriage return or enter key.
- Internet firewalls can restrict access to the sersock port. To ensure proper operation, be sure that TCP packets can be routed from the necessary control hosts to port 8548 on the camera.
- It is also important that this port be protected from general unauthorized access (e.g. the Internet at large).

5.8 Using Telnet to connect to the camera

5.8.1 Starting a Telnet session

To initiate a Telnet session on the camera from a Windows PC, select the Start Menu, then Run… and enter "cmd" to open a Command Prompt (MS-DOS) window. At the `C:\` prompt, enter the following, replacing `192.168.1.222` with your camera IP address.

```
telnet 192.168.1.222
```

You may specify the ZeroConf camera name of the camera instead of the IP address. For example, for the LE175 camera MAC ending in 0D:12:CD, the default Bonjour name is le175c-0d12cd.local.

The camera will respond with a prompt of `#`. At this point, it is possible to enter API commands and queries using the command line interface. For example, the following command returns the current firmware version information:

```
l version
```

The console can also be used to get and set camera properties:

```
l get exposure
l set autogain=1
```

5.8.2 Enabling and Disabling Telnet

To disable the Telnet feature, select the Passwords link on the Admin Mode tab of the web browser user interface, uncheck the Enable Telnet Daemon option. The change will be applied immediately. To maintain your change to the camera settings, select the Save Settings link.

The API property associated with the Telnet Daemon is the Boolean property `telnetd`. Telnet is enabled when `telnetd` is `true`. The HTTP commands to disable Telnet are as follows:

```
http://192.168.1.222/cgi-bin/set?telnetd=0
http://192.168.1.222/cgi-bin/save_settings
```

Avoid using a Telnet session to set `telnetd=0`, since the Telnet session will immediately terminate, leaving no opportunity to save settings.

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6

Web Interface User's Guide

6.1 Overview

This section describes the Network camera's web interface and associated web pages.

6.2 Main Web Interface

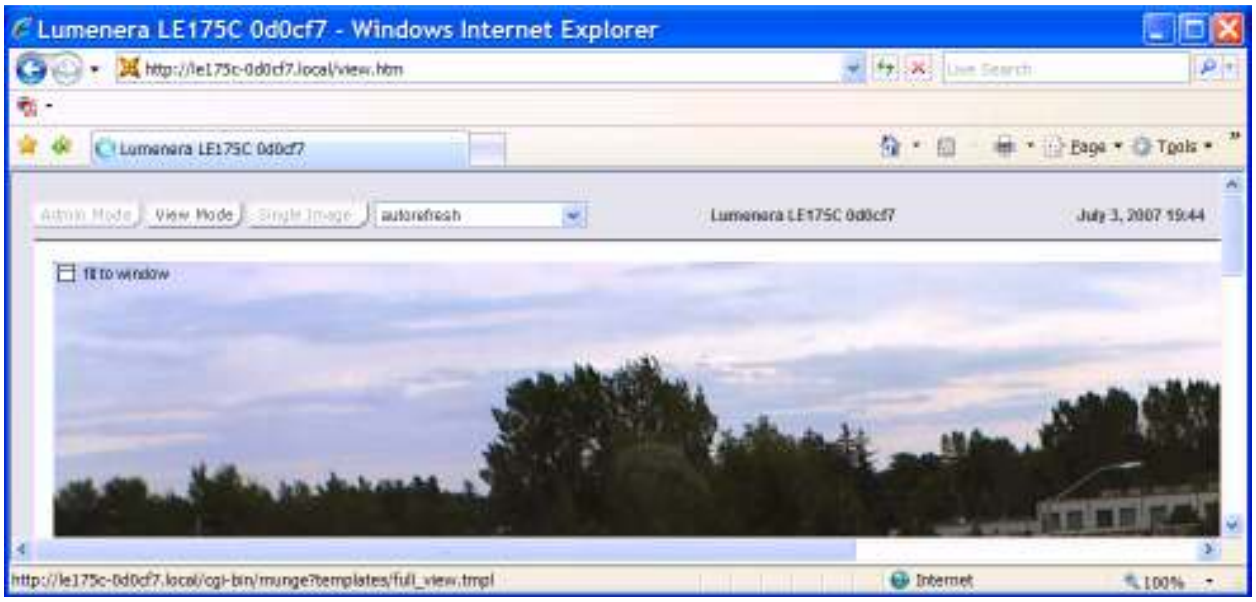

Figure 6-1 Main Web Page of Network Camera User Interface

The main web page, shown in Figure 6-1, provides images from the camera. By default, the camera web pages open in View Mode. View Mode provides full-size display of images from the camera. Click on the `fit to window` icon at the top left of the image to display the image in full screen mode without other controls. Click on the `actual size` icon in the top left of the screen to return to View Mode.

The image refresh rate is selectable through the drop down menu. By default the camera starts in auto-refresh mode, meaning that the web page will update as fast as the network will allow.

Figure 6-2 Buttons on Main Web Page

The View Mode web page also displays the camera model, part of its MAC address and the date and time currently set in the camera. Three buttons allow you to capture individual images, configure the camera settings or return to the main web page view as shown in Figure 6-2. The buttons are described in detail in subsequent sections.

6.2.1 Admin Mode Button

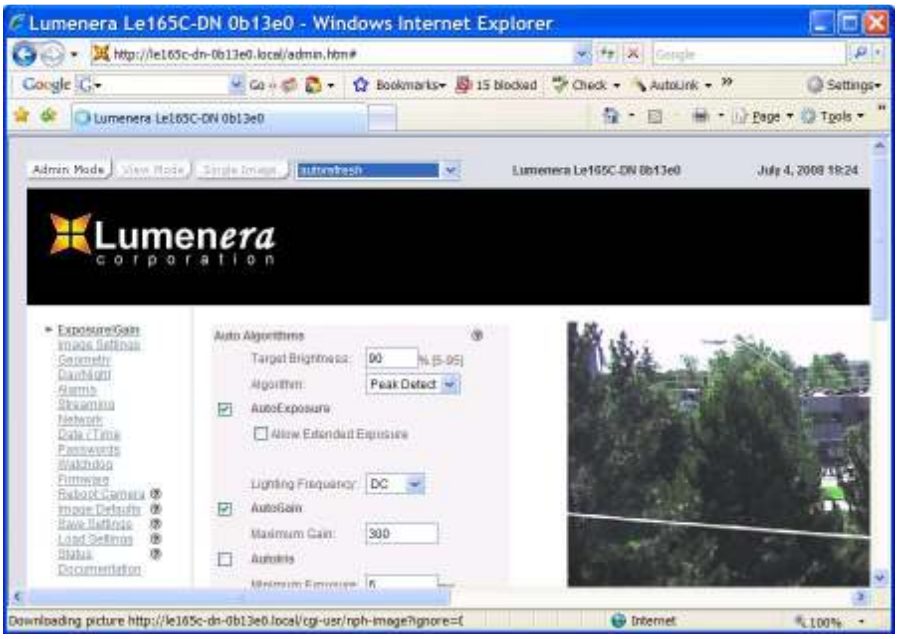

Figure 6-3 Links to Menus on the Admin Mode Tab

This button opens the Admin Mode web page as shown in Figure 6-3. Admin Mode allows you to configure and control the camera settings. A reduced size live camera image is provided at the right of the screen. By clicking on the links on the left of the screen, you can access more web pages to perform the following camera set-up tasks:

- Set exposure and gain settings (see Section 6.3)
- Set the image settings (see Section 6.4)
- Set geometry settings (see Section 6.5)
- Configure the day/night mode of the camera (see Section 6.6)
- Configure alarms (see Section 6.7)
- Control the video streaming (see Section 6.8)
- Setup the camera's network settings (see Section 6.9)

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- Set the current date and time (see Section 6.10)
- Assign passwords to lock the camera (see Section 6.11)
- Provide watchdog information and control (see Section 6.12)
- Update the camera's firmware (see Section 6.13)
- Reboot the camera (see Section 6.14)
- Load image defaults (see Section 6.15)
- Save current camera settings to and load settings from a configuration file (see Sections 6.16 and 6.17)
- Access documentation including the API functions and properties (see Section 6.18)

Note: Not all links or settings listed above are available for all camera models. Please refer to your camera's Admin Mode web page for a list of supported features and settings.

All the listed features and settings are described in more detail in the following sections.

6.2.2 View Mode Button

Select this button to return to the camera's main web page from the Admin Mode web pages.

6.2.3 Single Image Button

Select this button to capture a single video frame from the camera's video stream. It displays this captured frame in a separate web browser window. The image can be saved to a file by right-clicking the image and selecting the Save Picture As menu option. This button calls the `nph-image` API function.

6.2.4 Help buttons

Clicking on the question mark icons in the Admin Mode (see Figure 6-3) will open a new web browser window with the camera help displayed. The help is context-sensitive. For example, if you click on the question mark in the AutoAlgorithms area, you will link specifically to the part of the help document dealing with the camera auto-brightness control functions, as shown in Figure 6-4.

Figure 6-4 Context-sensitive help web page.

6.3 Exposure and Gain Control

Figure 6-5 AutoAlgorithms - Exposure and Gain Controls

This web page allows you to control the camera's exposure, gain and color gain settings as shown in Figure 6-5. It also provides control of the auto-brightness control (ABC) algorithms such as the auto-exposure, auto-gain and auto-iris controls. You can set the target brightness for these algorithms and set the type of algorithm to use. There can be up to four types of algorithms for calculating the brightness (luminance) of the images:

- Average: this algorithm calculates the average luminance in every image from the camera and determines if the brightness should increase or decrease based on the requested target brightness.
- Median: this algorithm uses the median luminance of the image to determine if the image brightness should change to be in line with the requested target brightness.
- Peak Detect: this algorithm looks at the bright areas (peaks) in the image to determine how to adjust the brightness of the image to coincide with the requested target brightness.
- Dark Detect: this algorithm is similar to the Peak Detect algorithm but instead looks at the dark areas to determine if any adjustments are required to the overall image brightness based on the requested target brightness.

Figure 6-6 Le045 and Li045 Exposure/Gain Controls

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The Le045 and Li045 cameras use high-performance wide dynamic range image sensors with unique properties for auto iris and white balance that are not present in other camera models as shown in Figure 6-6.

If the AutoIris option is enabled on the Le/Li045, the camera will adjust the aperture of a DC auto-iris lens to achieve the desired luminance when the system gain drops below the AutoIris Threshold. Lower thresholds require brighter scenes to engage the iris. If the threshold value is set too high then the iris will close too readily and the image will become grainy (noisy).

The white balance functions of the Le/Li045 can be controlled using a numerical "bias" value that corresponds to the light source color temperature. Larger positive values generate images with more saturated red tones in the image.

Figure 6-7 Lens Control Options for 35mm Lenses In Exposure/Gain Controls

For the large-format cameras, the Exposure/Gain menu also provides for remote control of the lens aperture and focus settings, shown in Figure 6-7. To control the aperture, disable the AutoIris option and use the - and + buttons to change the f-stop of the lens. A smaller f-number corresponds to opening the iris and admitting more light. To control the focus, use the arrow keys. The numerical focus parameter will also vary when the arrow keys are used.

Figure 6-8 White Balance Section of Exposure/Gain Controls

This web page also includes properties to set the current color gains and to enable the continuous white balance, as shown in Figure 6-8. The white balance function uses a gray world algorithm that assumes, on average, the image will be "gray" with equal weight in each color channel. There are four preset color balance ranges that help keep the continuous white balance within normal operating ranges: Default, Wide, Fluorescent, and Daylight.

Auto Window
The auto window defines the area that is used by the auto_algorithm when calculating autoexposure, autogain and whitebalance.

Figure 6-9 Auto Window Section of Exposure/Gain Controls

You can also define a region of interest (ROI) in which the auto features are applied, as shown in Figure 6-9. If the Auto Window check box is checked, you can change the area the camera uses to calculate the luminance for the auto-brightness control (ABC). By default, the camera uses the entire image size. To define the dimensions of the Auto Window, click the left mouse button and drag the mouse pointer in the preview image. You may also enter the Auto Window height, width, and offset by entering numerical values in the fields provided.

6.4 Image Settings Control

Figure 6-10 Image Settings Controls

The Network camera's Image Settings control web page, shown in Figure 6-10, allows control of the specific image properties listed below.

- Gamma: allows changes to brightness in the mid-tone range without affecting the maximum or minimum values.
- Contrast: provides a means to increase or decrease the contrast in images produced by the camera.
- Saturation (for both daytime and night time conditions available with day/night type cameras): adjusts the intensity of the color in images produced by the camera. Values in the range from 0 to 50 are useful for color images. For monochrome (black and white) images, such as in the night mode of camera with the Day-Night filter mechanism, the saturation is -100.
- Brightness: allows changes to the overall brightness of the images.
- Sharpness: allows the selection of different built-in edge enhancement algorithms. Four options are provided:

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  - Default: the default value that provides normal edge enhancement
  - Alternate: provides a less aggressive edge enhancement
  - High: provides a high edge enhancement
  - Off: turns off edge enhancement
- Lighting source: provides a correction algorithm to improve the image quality based on the light source in use. A color correction matrix applies a color correction to the image to compensate for frequency response of the lighting source. There are eight options available:
  - unity: does not alter the color values in the images.
  - default: applies the default color correction matrix to provide generic color correction good for most lighting sources.
  - chip_default: corrects for the spectral response of the sensor used on the camera. This correction matrix is generic and is good for most lighting sources.
  - fluorescent: corrects for the emission spectrum of most fluorescent lights.
  - daylight: improves the color accuracy in daylight.
  - incandescent: corrects for the emission spectrum of incandescent lights.
  - xenon_flash: corrects for the emission spectrum of xenon strobe flash lamps.
  - halogen: corrects for the emission spectrum of halogen lamps.
- JPEG settings: provides control over the quality and file size of the JPEG images produced by the camera. These properties dictate how much compression is performed on the image. There are two options available.
- JPEG quality: the minimum JPEG quality can be set manually or an automatic setting can be used. By default, the automatic JPEG quality setting is set which will limit the quality based on the image detail and the requested file size.
- Maximum Size: this property sets the maximum file size allowed for each image. The camera will sacrifice JPEG image quality to ensure that the maximum file size is not exceeded. By default, maximum file size is not set.

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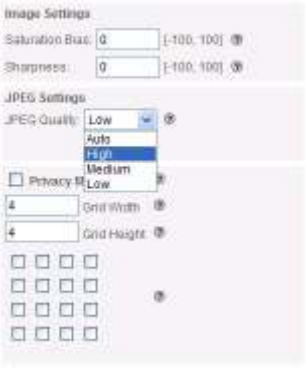

Figure 6-11 Image Settings Controls for Le045 and Li Series

The Image Settings controls are implemented in a simplified way in the Li series cameras, as shown in Figure 6-11. The JPEG quality is specified simply as Auto (default), High, Medium, or Low. In addition, for the Le045 and Li045 cameras with wide dynamic range image sensors, numerical sharpness and saturation values are the only options supported.

6.5 Geometry Configuration

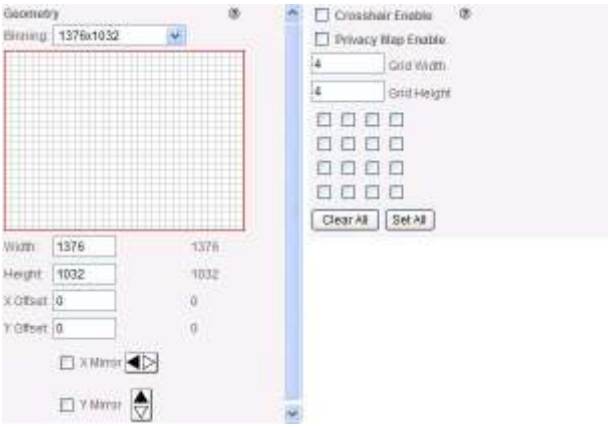

Figure 6-12 Geometry Settings

This web page, shown in Figure 6-12, allows you to configure image size and region of interest (ROI), to flip and mirror and apply privacy maps and other overlays to the images.

The properties that can be controlled are:

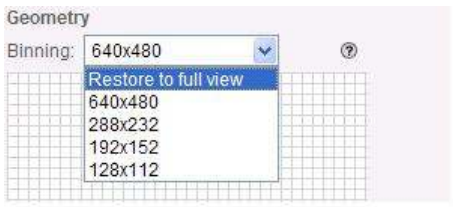

Figure 6-13 Binning/Subsampling Options In Geometry Settings

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- Binning/subsampling mode: these modes provide a full field of view (FOV) from the camera but reduce the image file size in bytes. For all binning modes shown in Figure 6-13, the pixels are summed together into one super pixel, based on the mode selected. For a 2x2 binning mode for example, 4 pixels would be summed together to create 1 super pixel and the image size would be reduced by a factor of 4. For all subsampling modes, many pixels are omitted for every pixel that is retained. Subsampling produces a similar reduction in the image file size as binning; however, the image brightness is similar to that of the full-resolution image.

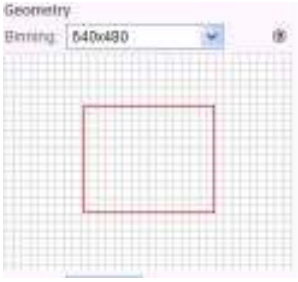

Figure 6-14 Geometry Grid

- Geometry grid: this grid pattern allows you to selectively choose a specific ROI and position on the sensor using the mouse as shown in Figure 6-14. Select the upper left corner of the ROI you wish and left-click and drag the mouse pointer to define the rectangle that you wish to set for the image ROI. When you release the left mouse button, the image dimensions will be set accordingly. This action sets the width, height, x and y offset properties of the ROI.
- Width: this property displays or sets the image ROI width.
- Height: this property displays or sets the image ROI height.
- X Offset: this property displays or sets the image ROI X offset value.
- Y Offset: this property displays or sets the image ROI Y offset value.
- X mirror: this check box mirrors the image.
- Y mirror: this check box flips the image.
- Crosshair Enable: enables or disables a crosshair overlaid onto the images returned from the camera. The crosshair can be used for aligning the camera during setup.
- Privacy Map Enable: enables or disables a privacy map overlay on the images. This feature is explained in more detail in Section 6.5.1.

6.5.1 Privacy Map

The privacy map feature allows you to obscure certain areas in the field of view of the camera. This feature is useful when the camera is deployed where certain

areas require privacy. For example, you may wish to mask a window on a privately owned building.

The privacy map dimensions can be altered using the Grid Height and Grid Width fields in the web interface. The mouse pointer can be used to enable particular squares in the privacy map. A check mark is displayed in each square when activated. Be sure to select the Save Settings link to store your changes in the non-volatile memory.

To configure the privacy map programmatically, you should understand how the privacy map is implemented in detail. The privacy map is an array or grid of privacy zones within the image. Each zone may be enabled (private) or disabled (visible). The privacy map width and height are, respectively, the number of columns and rows in the privacy map grid.

The `privacy_map` parameter defines the specific elements of the privacy map grid that will be marked private. The `privacy_map` is a binary value that is stored as a hexadecimal value. The number of bits in the privacy map is simply the product of privacy map width and privacy map height. The most significant bit of the privacy map value corresponds to the upper left privacy map grid element. The following bits correspond to the next grid element to the right until the end of the row. The following bits continue on the next row to the last bit which defines the bottom right grid element.

Note: The privacy map is defined based on the sensor coordinates and ignores the x and y mirror values. The privacy map is digitally mirrored (flipped) together with the image. In this way, privacy zones remain masked regardless of the image orientation.

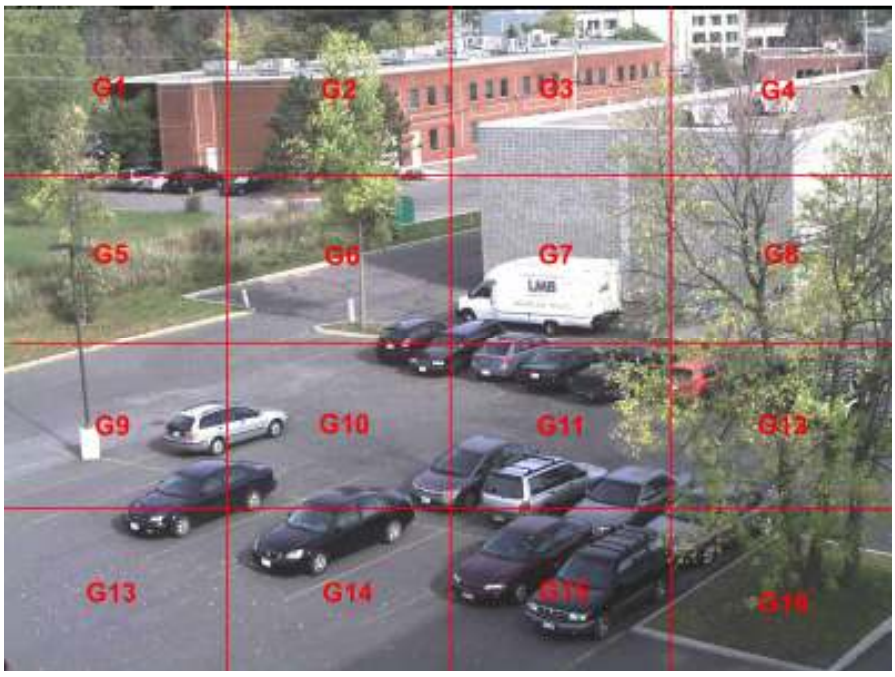

Figure 6-15 Image Illustrating the Privacy Map Grid

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The image shown in Figure 6-15 shows how the privacy map grid would be laid out if the privacy map dimensions were 4x4. The grid overlay in the following two images is shown for explanation purposes and is not visible in the images produced by the camera.

For example, if you wanted to block out the windows in the building at the top of the image (elements G2 and G3) and mask the location where the white van is (element G7), the privacy map value would be:

```
privacy_map = G2 G3 G7
```

Or, in binary:

```
privacy_map = 0110 0010 0000 0000
```

Or, in hexadecimal:

```
privacy_map = 0x6200
```

To set this privacy map in the camera, use the following instructions.

Using a telnet session:

```
# l set privacy_map_width=4 privacy_map_height=4
privacy_map=6200
```

Note: There is a limitation on the number of characters in the command line for a telnet session. The limit is about 32x16 for the privacy map grid. XML RPC may be required for setting fine privacy maps (above grid 32x16).

Using a web browser:

```
http://192.168.1.222/cgi-bin/set?privacy_map_width=4
```

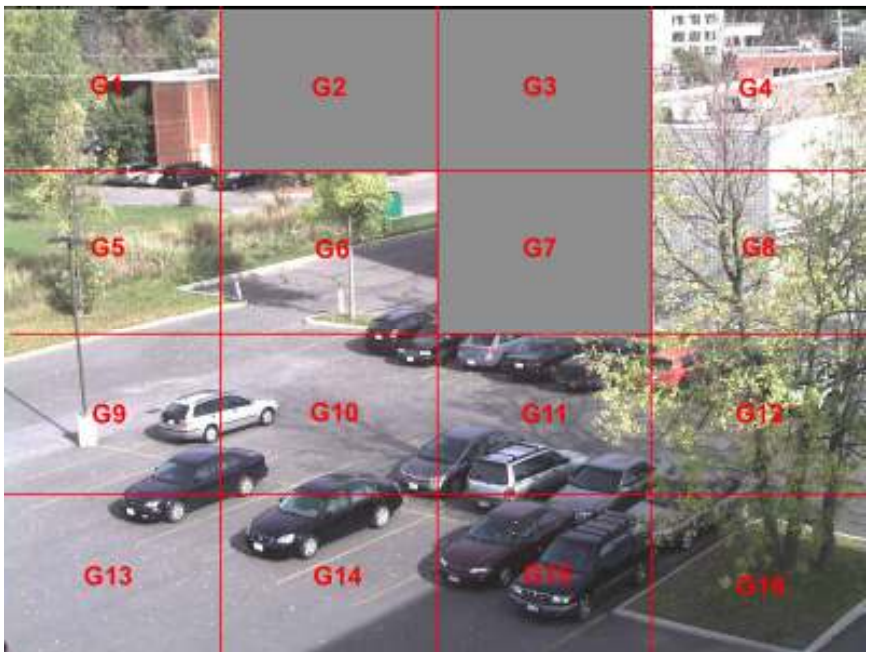

Figure 6-16 Image with Privacy Map Activated

```
&privacy_map_height=4&privacy_map=6200
```

Note: There is a limitation on the number of characters in the URL. The limit is about 128x28 for the privacy map grid. XML RPC may be required for setting fine privacy maps (above grid 128x28).

The resulting image is shown in Figure 6-16 with the privacy map applied above enabled.

6.6 Day/Night Control

Figure 6-17 Day/Night Settings

The Day/Night web page, shown in Figure 6-17, allows for custom settings and controls for the camera during daytime and night time conditions. It provides set points to state when the camera should switch between day and night modes.

The day mode applies in brightly lit conditions. In day mode, a color camera produces color images, and a camera with the "-DN" day-night option places the infrared-cut filter in its optical path.

When the environment becomes darker, the camera will enter night mode based upon a defined threshold condition. In night mode, the infrared-cut filter is removed from the optical path in order to admit more light and images returned from the camera are monochrome (black and white).

The top of the Day/Night web page provides Indoor and Outdoor buttons. Both buttons apply settings appropriate for working with North American (60 Hz) lighting powered by an AC supply. The Indoor button applies a lighting frequency of 60 Hz at all times. The Outdoor button applies a lighting frequency of 0 Hz (DC, daylight) in day mode and 60 Hz in night mode.

The web page provides detailed settings for both day and night modes, as described below:

- Stable Duration: This value sets the amount of time that the camera will wait before switching between modes. This value is measured in seconds. The threshold condition that the camera uses to determine if it is in this condition is defined by the Trigger Criteria values.

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- Trigger Criteria: Defines a threshold condition that results in the camera switching to day mode or to night mode, as appropriate. There are three types of criteria that can be used. Only one trigger criterion can be set at any time in the web interface. The Trigger Criteria entered under Day Settings should not overlap with that entered for Night Settings. To prevent oscillations between day mode and night mode, the Trigger Criteria should provide for a gap between the thresholds in which modes do not change. In engineering terms, this gap forms a hysteresis loop. The three criteria are listed below:
    - Exposure: threshold is based on the exposure time in milliseconds. Automatic control of the exposure produces short exposure times in bright conditions. As a factory default, when the exposure is greater than a certain value (e.g. exposure > 31), the camera will enter night mode. Short exposures or low gain (e.g. exposure < 19 or gain < 16) can be used to indicate daylight conditions and return the camera to day mode.
    - Luminance: threshold is based on the brightness of the image as a percentage of the maximum level (a value between 0 and 100). For example, the camera may be configured to enter night mode when the luminance is low (luminance < 10), and to return to day mode when the luminance is high (luminance > 40).
    - Gain: threshold is based on the camera's current gain setting (value between 0-300). Automatic gain control increases the gain in dark conditions. For example, the camera may be configured to enter night mode when the gain is high (gain > 32), and to return to day mode when the gain is low (gain < 16).
- Saturation: This value sets the image saturation which defines how intense the color is in the images. The saturation is normally set to a value between 0 and 50 for a color camera in day mode. A saturation value of 0 provides a color image without any additional saturation. A larger saturation value between 0 and 100 produces bolder colors. A value of -100 removes all color information producing a monochrome (black & white) image, and is the default for cameras with the "-DN" day/night filter option when in night mode.
- Lighting Frequency: Aligns the camera's exposure value with the frequency of the light source so that there is no banding or flickering in the video stream. There are three values for this parameter:
    - DC: this means that the light does not flicker or runs off a DC power source. This is correct setting to use in day mode for outdoor settings, where the light source is sunlight.
    - 50Hz: this means that the light source uses an AC power source and that source runs at 50 Hz. This is the standard in Europe, the United Kingdom, Australia, New Zealand, and China.

- 60Hz: this means that the light source uses an AC power source and that source runs at 60Hz. This is the standard in North America, Brazil, South Korea, and Taiwan.

6.7 Alarm Settings

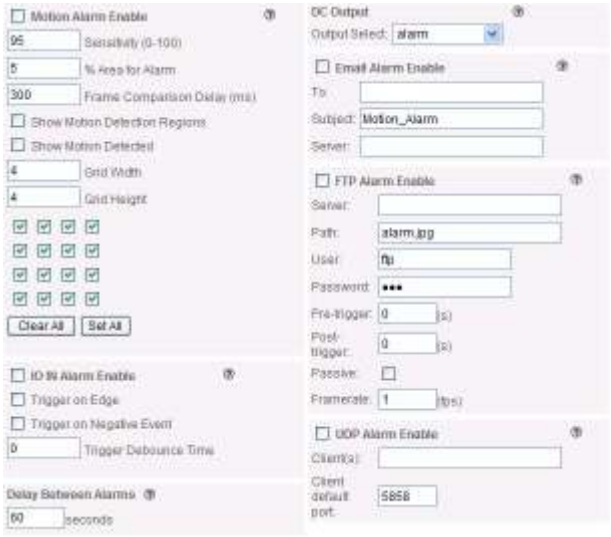

Figure 6-18 Controls Included In the Alarms Page on the Web Interface

The setup of alarm triggers and alarm responses uses the Alarms page of the web interface, shown in Figure 6-18. The Network camera can trigger on two basic types of alarms, a motion alarm or a GPIO event alarm. In addition, the Li-series cameras can be provided with embedded video content analysis software to create specific rules that generate alerts based on the behaviors of people, vehicles, and objects.

More information on how to setup and configure the alarm settings is presented in the subsequent sections. However, the following two parameters are common to all alarms.

- Delay Between Alarms: The minimum time, measured in seconds, between alarm event notifications sent by the camera. This value can be used to control the frequency of alarm notifications during an alarm event. A delay of at least 1 second is recommended.
- DC Output: This defines the mode of operation of the GPIO output port (the `output_select` property), as described in Section 4.6. The `output_select` property allows for six types of output:
  - on: provides a constant DC output voltage
  - off: deactivates the GPIO output.
  - alarm: outputs an alarm event notification pulse.

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- start of readout: outputs a start_of_readout signal upon readout of the first line from a rolling-shutter image sensor.
- strobe: outputs a strobe signal that can be used to synchronize the image exposure for global-shutter image sensors with an external strobe lamp (flash lamp, LED array, etc.)
- watchdog_ping: outputs a signal periodically to show the status of the camera. A steady high level indicates normal operation. Pulsing of the GPIO output indicates a failure to ping the IP address specified in the Watchdog page (`watchdog_ping` API property).

6.7.1 Detecting Alarm Events

6.7.1.1 Motion Alarms

Motion alarms can be turned on by checking the Motion Alarm Enable check box on the Alarms web page. This feature does a frame comparison that analyzes changes in individual pixels between frames.

The user defines a minimum number of pixels that need to change by a minimum amount within a predefined area on the image, known as the motion map.

The parameters to define a motion alarm are:

- Sensitivity: this parameter can take a value between 0 and 100% and represents the sensitivity to change in a cluster of pixels in order to trigger an alarm. A value of 100 indicates the greatest sensitivity. Suggested value: 80.
- % Area of Alarm: the size of the cluster of pixels that must change in order to trigger the motion alarm. It is expressed a percentage of the specified motion detection area (0-100%). Suggested value: 10.
- Frame Comparison Delay: the time in milliseconds between frames that are compared. Suggested value: 300.
- Grid Width: this parameter defines the number of columns in the motion map. The API interface allows a maximum of 256 columns that can be defined, depending on the camera model, however the web interface only allows up to 16.
- Grid Height: this parameter defines the number of rows in the motion map. The API interface allows a maximum of 256 rows that can be defined, depending on the camera model, however the web interface only allows up to 16.

Once you have defined all the motion alarm parameters, you can then select which elements of the motion map grid (defined by Grid Width and Grid Height) that the camera will analyze for motion. You can also set the motion map by converting the elements into a hexadecimal value as defined for privacy maps in Section 6.5.1. You can set the motion map to use the same pattern used in the privacy map example shown in Figure 6-15:

```
motion_map = G2 G3 G7
```

Or, in binary:

```
motion_map = 0110 0010 0000 0000
```

Or, in hexadecimal:

```
motion_map = 0x6200
```

To set this motion map in the camera, use the following instructions.

Using a telnet session:

```
# l set motion_map_width=4 motion_map_height=4
motion_map=6200
```

Note: There is a limitation on the number of characters in the command line for a telnet session. The limit is about 32x16 for the motion map grid.

Using a web browser:

```
http://192.168.1.222/cgi-bin/set?motion_map_width=4
&motion_map_height=4&motion_map=6200
```

Note: There is a limitation on the number of characters in URL. The limit is about 128x28 for the motion map grid.

With the motion map defined, you can test motion detection settings using the following two options in the Alarms web page.

- Show Motion Detection Regions: this option displays the active elements of the motion map grid on the image from the camera. The regions are highlighted in light gray rectangles against a darker background image as shown in Figure 6-19.

Figure 6-19 Image With Show Motion Detection Regions Feature Active

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- Show Motion Detected: this option displays the motion that was detected by the camera by applying a white overlay that appears as a "ghosted image" trail against a darker background image, as shown in Figure 6-20.

Figure 6-20 Image with the Show Motion Detected Feature Active

6.7.1.2 GPIO Input Alarms

The Network camera can also receive alarm signals through its GPIO input terminals. The input can take a 5V signal. When this alarm mode is enabled, the camera polls the input and triggers an alarm when the signal changes. There are a few options that describe the type of signal events needed to trigger an alarm.

- Trigger on Edge: when selected, the input alarm will trigger on the change in voltage in the signal, that is, on either the rising or falling edge. By default, the alarm will use a voltage level as its trigger type.
- Trigger on Negative Event: when selected, the input alarm will trigger on a low voltage when in level trigger mode, and on a falling edge when in edge trigger mode.
- Trigger Debounce Time: this defines a debounce time, in milliseconds, that the camera will wait to confirm that the alarm signal trigger is valid.

6.7.2 Alarm Event Notifications

Once the camera detects an alarm event, a few options are available to send notifications of this event to the outside world. Any or all options can be used simultaneously.

6.7.2.1 Email Alarm Notifications

The camera can be configured to send an email to a specific email address whenever an alarm event is detected. To enable and configure this type of alarm notification, set the following values:

To: enter a valid, accessible recipient email address
Subject: the subject field of the notification email
Server: the IP address of the mail server to use to send the email

6.7.2.2 FTP Alarm Notifications

An FTP alarm notification can be configured to upload images before and after the alarm event to an FTP server. To enable and configure this type of alarm notification, set the values accordingly. For more information on these values and their definitions see Section 6.8.1 for details of the Streaming menu in the web interface.

To configure alarm FTP streaming from a telnet or serial console

The Alarm FTP properties can be set up using the following commands using a telnet or serial console.

```
l set alarm_ftp_server=111.222.255.44
l set alarm_ftp_user=YourFTPlogin
l set alarm_ftp_password=YourFTPpassword
l set alarm_ftp_path=FileName%Y%j%H%M%S%%Q.jpg
l set alarm_ftp_pre_trigger=3
l set alarm_ftp_post_trigger=3
l set alarm_ftp_framerate=1
```

6.7.2.3 UDP Alarm Notifications

The Network camera can be configured to send UDP alarm notifications. To configure the camera to send UDP alarm notifications, set the following values:

- Client(s): a comma-separated list of target client IP addresses that will receive UDP alarm notification packets. To specify a specific port for each client, you can define the port number by appending the appropriate port number preceded by colon. Otherwise, the camera will use the default port number defined in the Client default port parameter.
- Client default port: this parameter defines the default client port number to use when a specific port number is not provided in the Client field.

Unless a UDP alarm packet is acknowledged, it will be sent again at one second intervals up to a total of 3 alarm messages. The camera sends the alarm on the port provided and will listen for any acknowledgement message on the same port.

The format to acknowledge receipt of a UDP alarm packet must be exactly:

```
<event_number>\r\nACK\r\n
```


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where <event_number> is the event number received in the UDP event packet, ACK is sent as upper case ASCII text, \r = Chr(13) represents a carriage return, and \n = Chr(10) represents the new line character.

An example of the UDP alarm packet and the reply follows:

Alarm packet:

```
---
1234
192.168.2.107
00:0b:e2:0b:03:e3
Fri Jun 8 10:49:31 2007
motion-centroid x:814 y:641 area:89.4222
```

Reply:

```
1234\r\nACK\r\n
```

6.8 Streaming Control

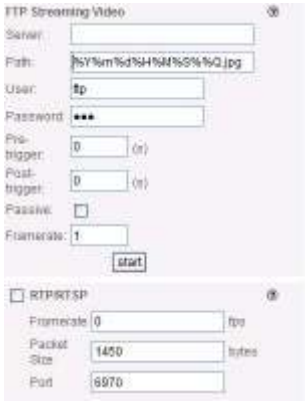

Figure 6-21 Streaming Control in Web Interface

Using the options on the Streaming page of the web interface, shown in Figure 6-21, the Network camera can be configured to automatically upload images to an FTP server or to stream video frames via RTP/RTSP.

6.8.1 FTP Streaming Video

To upload images from the camera to an FTP server, set up the camera's FTP Streaming Video properties as follows:

- Server: the target FTP server that will receive the captured images
- Path: the file name and path to use for the alarm files. Specific examples are provided below.
- User: the user name to use to access an account on the FTP server
- Password: the password for the FTP user account

- Pre-trigger: duration in seconds of pre-event images to send to the FTP server. For FTP file transfers configured from the Alarms page, the trigger event may correspond to a motion alarm event or to a trigger signal on the GPIO input. In the Streaming page, the trigger event corresponds to the user clicking on the Start button.
- Post-trigger: duration in seconds of post-event images to send to the FTP server
- Passive: enables the passive mode for the FTP file transfers
- Framerate: the FTP frame rate to use when sending images to the FTP server. If value is higher than current camera frame rate, the camera will provide images as fast as possible.

FTP path names

The Path value can include date and time information and/or image numbers into the image file name. This can be done by specifying the appropriate field in the file name. Two special keys are provided, %i for the relative image number, and %%Q for the portion of the time in milliseconds.

The following list contains some of the common date/time fields:

%Y: Replaced by the year as a decimal number (for example, 1997).
%j: Replaced by the day of the year as a decimal number [001, 366].
%m Replaced by the month [01, 12]
%d Replaced by the day of the month [01, 31]
%H: Replaced by the hour (24-hour clock) as a decimal number [00, 23].
%M: Replaced by the minute as a decimal number [00, 59].
%S: Replaced by the second as a decimal number [00, 59].

A more complete list of date/time fields can be found online:
http://www.opengroup.org/onlinepubs/009695399/functions/strftime.html

Example with relative image number

```
image%%05i.jpg
```

Here "%%05i" is the relative image number. The alarm or start event corresponds to number zero. Pre-trigger images are assigned negative image numbers. Post-trigger images are assigned positive numbers. In this example, the relative image number is formatted to five places, with example image file names image00000.jpg (the trigger event), image-0001.jpg (the first pre-event image), and image00001.jpg (the first post-event image).

Example with year, day, time

```
image%Y%j%H%M%S%%Q.jpg
```


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Long-term FTP of images

To send time-lapse JPEG images at relatively long intervals on an ongoing basis, you need only to make the appropriate settings in the Streaming menu. The Framerate parameter for FTP streaming accepts decimal numbers less than 1. For example, to transmit an image every 15 minutes, enter 0.001111 or 1/(900 sec.). To send an image every hour, enter 0.0002777 or 1/(3600 sec.).

To test the long-term image transfer, set Post-trigger to a large number (e.g. 7 days or 7*24*60*60 = 604800 seconds). Please note that most FTP servers are configured to reset connections approximately every 2 hours. You must reconfigure your FTP server to avoid this during very long term operation.

FTP streaming using HTTP interface

The following example includes a path name that includes the date and time the file name of each image transferred using FTP:

```
http://192.168.1.222/cgi-bin/
ftp_images?path=image%25Y%25j%25H%25M%25S.jpg
&server=111.111.111.111&pre=1&post=1&framerate=1
&user=UserName&password=YourPass
```

In the example above, substitute `192.168.1.222` with your actual camera IP address. Substitute `111.111.111.111 with` the actual FTP server address.

Note: The format of the HTTP request must use URI escape code (%25) for the "%" characters in the path parameter of the `ftp_images` API function. For details of URI escape codes, see:

http://www.dragonwinds.com/resources/html-codes.shtml

FTP streaming from telnet or serial console

To initiate an FTP image transfer from a telnet or serial console, first set the Alarm FTP API properties. Then use the specific format of the `ftp_images` function indicated below to transfer an image on demand.

The Alarm FTP properties can be set up using the web interface or via the following commands using the telnet or serial console.

```
l set alarm_ftp_server=111.222.33.44
l set alarm_ftp_user=YourFTPlogin
l set alarm_ftp_password=YourFTPpassword
l set alarm_ftp_path=YourFileName
l set alarm_ftp_pre_trigger=0
l set alarm_ftp_post_trigger=0
l set alarm_ftp_framerate=1
```

To transfer images, execute the following command.

```
l ftp_images server=`/bin/l_get_escaped.sh
alarm_ftp_server` user=`/bin/l_get_escaped.sh
alarm_ftp_user` password=`/bin/l_get_escaped.sh
alarm_ftp_password` path=`/bin/l_get_escaped.sh
alarm_ftp_path` pre=`l get alarm_ftp_pre_trigger`
post=`l get alarm_ftp_post_trigger` framerate=`l get
alarm_ftp_framerate`
```

6.8.2 RTP/RTSP Video Streaming

The Network camera can also be configured to use the RTP/RTSP protocol to stream video. To enable and configure the camera to stream video using this protocol, set the following parameters:

- Framerate: defines the frame rate at which the camera will provide video images. If this value is larger than can be supported by the current camera image settings, the camera will provide video frames as fast as possible.
- Packet Size: defines the RTP packet size to use to ensure that there is no Ethernet fragmentation. The recommended packet size is 1450 bytes. This value ensures that little to no fragmentation will occur in most cases.
- Port: defines the RTP base port to use. This number should always be an even valued number.

The URI for the client to request video from the camera is:

```
rtsp://192.168.1.222
```

Section 2.3.7 provides instructions for playing RTSP streaming video in QuickTime.

6.8.3 Analog Output

Le045 and Li-series cameras include a BNC connector on the rear panel for analog video output. The analog video output is provided for use by camera installers to assist with aiming the camera and adjusting the focus. As described in Section 4.9, the Streaming menu on cameras with analog output provides an option to disable the analog output after the camera is installed. Use the Save Settings link to maintain this change to the camera settings.

6.9 Network Settings

The Network web page allows you to control the network settings of the camera.

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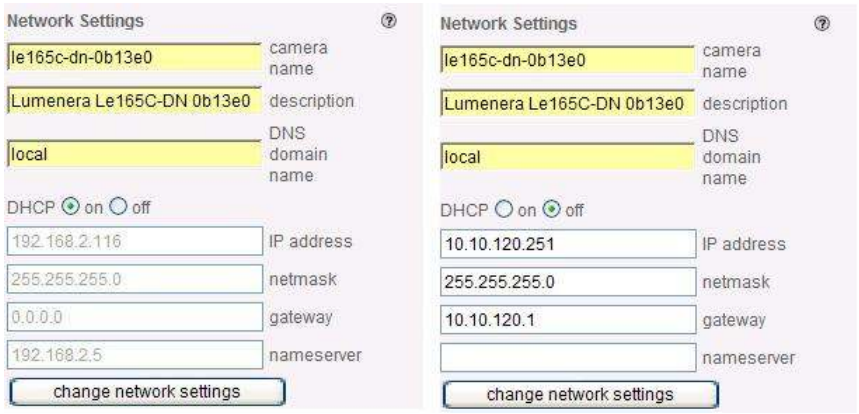

Dynamic IP address, DHCP on (factory default)

Static IP address, DHCP off (typical deployment).

Figure 6-22 Network Settings

The configurable properties include:

- Camera name: the host name for the camera (overwritten if DHCP server passes a hostname)
- Description: a text string describing the camera
- DNS domain name: the Domain Name Server (DNS) domain name used by the camera (can be overwritten by DHCP server)
- DHCP: enable or disable Dynamic Host Configuration Protocol (DHCP)
- IP address: the current camera IP address (if manually setting IP address, new address will be used after you Save Settings and reboot)
- Netmask: the current subnet mask (if manually setting subnet mask, new value will be used after you Save Settings and reboot)
- Gateway: the current gateway address (if manually setting gateway address, new address will be used after you Save Settings and reboot)
- Nameserver: the current nameserver address used by the camera (if manually setting nameserver address, new address will be used after you Save Settings and reboot)

To programmatically set the camera's network properties:

1. Set IP address, netmask, gateway (optional), & nameserver (optional).
2. Disable DHCP.
3. Save Settings to the flash memory.
4. Reboot the camera.

The HTTP/CGI commands are as follows. Property values are URL escaped, so substitute %2E for the "." character in the IP address or netmask.

```
/cgi-bin/set?ipaddr=123%2E123%2E123%2E123
/cgi-bin/set?netmask=255%2E255%2E255%2E0
/cgi-bin/set?gateway=123%2E123%2E123%2E1
/cgi-bin/set?nameserver=123%2E123%2E123%2E5
/cgi-bin/set?use_dhcp=0
/cgi-bin/save_settings
/cgi-bin/reset
```

For details of URI escape codes, see:

http://www.dragonwinds.com/resources/html-codes.shtml

6.10 Date/Time Configuration

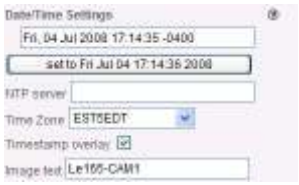

Figure 6-23 Date/Time Settings

The Date/Time web page allows one to control the camera's current time and date settings, as shown in Figure 6-23. For the Le045 and Li series cameras, the camera does not have a battery backup of the real time clock, making configuration of the NTP server especially important.

The controllable properties are as follows:

- Date/Time: displays the current date and time set in the camera. This value can be manually updated or can be synchronized with your computer by using the button labeled <your computer's current date and time>, below this field.
- NTP server: defines a Network Time Protocol (NTP) server where the camera can retrieve the current time. Multiple time servers can be used by adding them to this field and separating each one with a white space.
- Time Zone: defines the time zone in which the camera is operating.
- Timestamp overlay: allows the camera to overlay a timestamp onto the images using white text displayed on a black strip in the top 8 rows of the image.
- Image text: defines the text that separates the date from the image number in the timestamp area of the JPEG image. It can take up to 15 characters. The following characters cannot be used in this field: tilde "~", vertical bar "|" and the curly braces "{", "}". Lower case characters may be entered, but they will be rendered as upper case in the overlay.

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6.11 Passwords Configuration

Figure 6-24 Passwords Dialog

The Passwords web page, shown in Figure 6-24, allows both a user and administrator password to be configured on the camera. You can also enable and disable the telnet or serial port console access to the camera.

The `admin` (administrator) and `user` passwords ensure that all access to the camera is controlled and that settings are not changed indiscriminately. The administrator login is always `admin`. The user login is always `user`. Each has its own password. One `user` and one `admin` password can be set in the camera.

With a valid `admin` password, all available functions of the camera may be controlled. All functions in both View Mode and Admin Mode can be used.

With a valid `user` password, the limited privileges listed below are available to view images or query camera settings. With the `user` access level, the View Mode page is available, but all functions in the Admin Mode are locked out. Each available `user` function is associated with a function in the /cgi-usr/ path in the camera file system.

- Transfer an MJPEG stream, /cgi-usr/nph-video in the API
- Transfer a single JPEG image, /cgi-usr/nph-image.jpg
- Get a camera property, /cgi-usr/get?exposure
- View firmware version information, /cgi-usr/version

The following fields are associated with setting passwords in the Passwords web page:

User Name: defines the user name (`admin` or `user`) needed to access the account. The user names are pre-defined and cannot be changed.

Set Password: defines the new password for this account.

Confirm Password: ensures that password is properly set.

Once the password has been typed in both locations, the Set button will apply this password to the account.

6.12 Watchdog Control

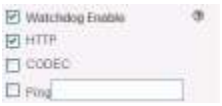

Figure 6-25 Watchdog Menu

The Watchdog web page, shown in Figure 6-25, enables or disables the watchdog task. This task can be used to monitor some other camera tasks such as:

- HTTP: when enabled, the watchdog monitors the web server on the camera to ensure that it is functioning correctly. It is recommended that this watchdog setting be enabled on the camera.
- CODEC: when enabled, the watchdog monitors the camera codec/imager status to ensure that they are functioning correctly. This setting is not typically used.
- Ping: when enabled, the watchdog monitors network communications with a specified address. The field provided is used to enter an IP address which this task will ping periodically. If the ping task does not communicate with the watchdog task periodically, the watchdog will assume that network communications have failed and reboot the camera to correct the issue.

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6.13 Firmware Settings

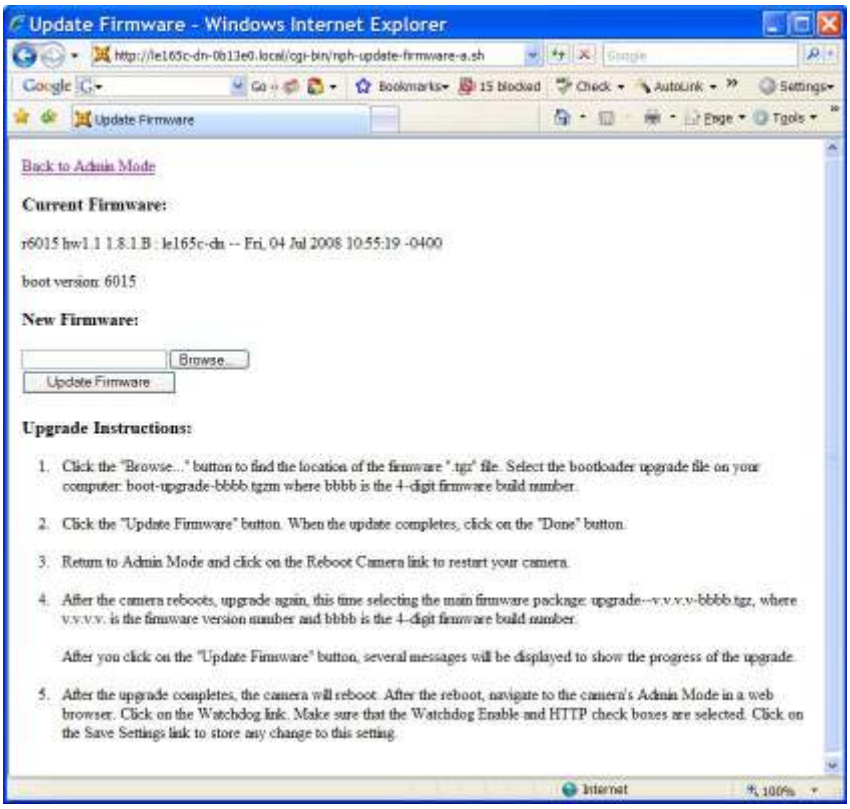
Update Firmware - Windows Internet Explorer
Update Firmware
Back to Admin Mode
Current Firmware:
r6015 hw1.1 1.8.1.B : le165c-dn -- Fri, 04 Jul 2008 10:55:19 -0400
boot version: 6015
New Firmware:
Browse...
Update Firmware
Upgrade Instructions:
1. Click the "Browse..." button to find the location of the firmware ".tgz" file. Select the bootloader upgrade file on your computer: boot-upgrade-bbbb.tgzm where bbbb is the 4-digit firmware build number.
2. Click the "Update Firmware" button. When the update completes, click on the "Done" button.
3. Return to Admin Mode and click on the Reboot Camera link to restart your camera.
4. After the camera reboots, upgrade again, this time selecting the main firmware package: upgrade--v.v.v.v-bbbb.tgz, where v.v.v.v. is the firmware version number and bbbb is the 4-digit firmware build number.
After you click on the "Update Firmware" button, several messages will be displayed to show the progress of the upgrade.
5. After the upgrade completes, the camera will reboot. After the reboot, navigate to the camera's Admin Mode in a web browser. Click on the Watchdog link. Make sure that the Watchdog Enable and HTTP check boxes are selected. Click on the Save Settings link to store any change to this setting.

Figure 6-26 Firmware Menu

The Firmware web page provides information on the current firmware and provides the means to update it. In Figure 6-26, the current firmware version is 1.8.1.B. For more information on how to update the camera's firmware, please refer to Section 2.5.

6.14 Reboot Camera Control

This Reboot Camera web link provides instant control to reboot the camera. Before rebooting the camera, it is important to use the Save Settings control to store any desired settings changes to the non-volatile memory. When the Reboot Camera link is selected, an on-screen dialog will request confirmation from the user before resetting the camera.

Note: Reboot the camera only when settings have been changed that require a reboot or if the camera is not functioning correctly.

6.15 Image Defaults Settings

The Image Defaults web link resets the image settings to their factory default values. When the Image Defaults link is selected, an on-screen dialog will request confirmation from the user before applying Image Defaults.

6.16 Save Settings Control

The Save Settings web link allows you to save the current camera settings to non-volatile memory. These settings will be applied each time the camera reboots. When the Save Settings link is selected, an on-screen dialog will request confirmation from the user before saving settings to memory. It can take several seconds to save settings. A dialog will be displayed to indicate when the Save Settings operation has completed.

6.17 Load Settings Control

The Load Settings web link resets the current camera settings with the ones stored in the non-volatile memory. When the Load Settings link is selected, an on-screen dialog will request confirmation from the user before loading settings from memory.

6.18 Status summary

The Status link will display a summary of the current camera status in a web page user interface. An example of the Status output is shown in Figure 6-27. The summary takes several seconds to display. The Status information indicates the current state, and does not indicate any configuration changes that will be applied at the next reboot.

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Figure 6-27 Status summary output

6.19 Documentation

The Documentation web page provides access to the on-camera documentation. Included in this documentation are application notes, and programming guide.

6.20 Pan-Tilt-Zoom (PTZ) Controls

Lumenera pan-tilt-zoom (PTZ) camera systems work with high-quality, field-proven enclosures and pan-tilt motors.

The PTZ systems accept standard-protocol commands over the network on port 8548. The usual PTZ control protocol is Pelco-D. PTZ control commands received by the camera are relayed via the camera's RS232 serial interface to a controller board that drives the pan-tilt motor and motorized zoom lens.

For PTZ camera systems, the "PTZ" button is displayed in the Admin Mode of the web browser user interface as shown in Figure 6-28. The PTZ features in the web browser are active only if the camera settings include ptz_enable=1 with

appropriate settings for serial_use ("accessory") and serial_speed (baud rate of 2400 bps). These settings are normally made at the factory.

Figure 6-28 PTZ button in Admin Mode

Clicking on the PTZ button launches a new web browser window with PTZ controls as shown in Figure 6-29.

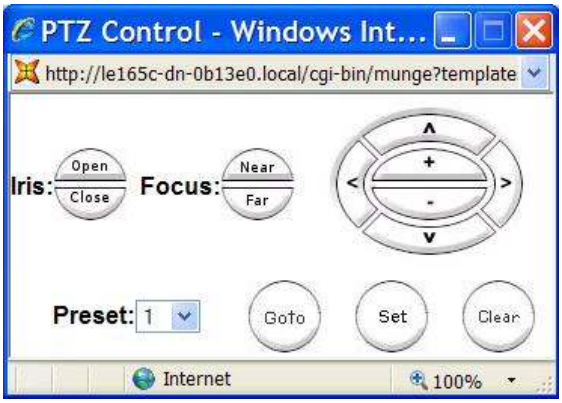

Figure 6-29 PTZ control window

The following are the functions available in the PTZ Control window. Holding down a button or pressing a button multiple times will provide multiple steps of adjustment of the motorized lens (zoom, focus, and iris) or pan-tilt motor.

- Lens controls
  - Iris: open or close the iris (lens aperture).
  - Focus: focus on near (foreground) or far (background).
  - + (plus sign) : zoom in (telephoto).
  - - (minus sign) : zoom out (wide angle).
- Pan/Tilt Arrows – according to the direction
  - Pan left/right, or
  - Tilt up/down.
- Preset – a stored lens & pan-tilt position
  - Select a preset number from the drop-down menu.
  - Click on the "Goto" button to go to the selected preset position.
  - Click on the "Set" button to store the present lens and pan-tilt positions as the selected Preset number.
  - Click on the "Clear" button to clear the selected Preset number.
  - Up to 32 presets may be stored.

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- PTZ presets are preserved in the event of a reboot, power loss, or factory reset, independently of the "Save Settings" function that is used to store other camera settings.
- The preset stores the pan, tilts, zoom, and focus. The preset does not include the iris setting.

A1

Glossary

ABC — Auto Brightness Control. As the image grows darker, ABC will apply the following measures:
1. Open the DC-autoiris lens, if present
2. Increase exposure up to the `autoexposure_knee`
3. Increase (analog) gain up to the `autogain_knee`
4. Increase exposure up to the `maximum_exposure`
5. Increase gain up to the `maximum_gain`

API — Application Programming Interface

CGI — Common Gateway Interface.

CRLF or **=\r\n** — Denotes the combination of the carriage return and line feed characters

DC iris — Cameras in the CS-mount format support DC-iris lenses, also called galvanometric or direct-drive lenses. Video autoiris lenses are not supported.

DHCP — Dynamic Host Control Protocol. By default, a camera will attempt to locate a DHCP server from which it will obtain an IP address.

DNS — Domain Name Server

EXIF — Exchangeable Image File Format. The Lumenera Network cameras produce JPEG images with an EXIF-compliant header. The metadata tags include information identifying Lumenera as the manufacturer, a frame number, the time in seconds, and the time in microseconds for each image.

FQDN — Fully Qualified Domain Name

FTP — File Transfer Protocol. In the camera this may be used to transfer images to a server on demand, upon motion, or upon receiving a signal on the GPIO input.

Gamma — A parameter that specifies a nonlinear characteristic for the mid-tone brightness level in the image. A value of 1.4 is typical. See `gamma` in the API property reference.

GPIO — General Purpose Input and Output. The cameras are equipped with one pair terminals for input and another for

	output. Both are optically isolated to minimize the risk of accidental electrical damage to the camera.
HTTP	Hyper Text Transfer Protocol. The data throughput for Lumenera Network cameras over HTTP is 1.5 MB/s and about 50% greater over UDP.
IP	Internet Protocol.
IR	Infrared. The cameras use silicon-based imagers and as such are sensitive to near-infrared wavelengths from about 700 nm to about 1100 nm. For some color cameras, the '-DN' day/night version provides the ability to detect IR light. An infrared-cutoff filter is used in daylight conditions to provide accurate color rendition. An uncoated infrared-transparent glass is used during night time conditions to boost the sensitivity of the camera. Images are normally rendered as monochrome (black and white) in night mode.
JPEG	Joint Photographic Experts Group. Denotes an image compression format that is commonly used in computing. The compression procedure includes encoding the image in the YCbCr color space, downsampling color (chroma, Cb, Cr) information, dividing the image into an array of 8x8 pixel cells, computing the discrete Fourier cosine transform of each cell, quantization of brightness information, and entropy coding. The associated file format used in computing is called JFIF for JPEG File Interchange Format. See also `EXIF`.
MAC	Media Access Control address. The MAC consists of six bytes expressed as hexadecimal values. For Lumenera products, the MAC is of the form 00:0B:E2:0D:04:AB. The first three octets (00:0B:E2) identify Lumenera as the manufacturer and the last three octets (0D:04:AB in this example) vary from one camera to the next. The MAC can be used to derive the link-local IP address of the camera by converting the last two octets to decimal values using the following formula 169.254.(93+MAC5).MAC6. For the example shown, MAC5=4, MAC6=AB=171 (decimal), so the link-local address is169.254.97.171.
MD5	A commonly used 128-bit cryptographic hash function. `User` and `Admin` passwords on Lumenera cameras can be set to use the MD5 hash of the password. See `user_password` and `admin_password` in the Network Camera API Manual for more information.
MJPEG	Motion JPEG. A video stream composed of a series of JPEG images, in which every frame updates the entire field. While

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	other formats that update only the changes between key frames can consume less bandwidth under favorable conditions, MJPEG provides an optimal balance between data compression and image quality under all conditions and a complete update of every image.
NPH	No Process Header.
NTP	Network Time Protocol. The API property `ntp_servers` is provided to allow one to specify the IP addresses of one or more NTP servers from which the camera's real-time clock may be updated.
PTZ	Pan-Tilt-Zoom. A PTZ camera is equipped with a motor to pan the camera to the left or right and tilt the camera up or down. The zoom lens is also motorized to change the field of view between the extremes of telephoto and wide angle.
RAW	The term "RAW image" refers to the binary image data as recorded by the image sensor. No corrections or image processing are applied to this image. In particular, no JPEG compression has been applied. For color images, no demosaicing of the Bayer pattern of color filters on the pixels has been applied to generate RGB values for each pixel of the image. See `raw_mode` in the Network Camera API Manual for more information.
RFC	Request For Comments. A numbered series of memoranda published on the Internet describing innovations in computer network engineering. The Internet Engineering Task Force (IETF) may adopt some RFCs as standards.
RGB	Red, Green and Blue. A color image in which each pixel is assigned Red, Green, and Blue components. In RGB color image capture, each pixel of the image sensor acquires only the signal for only one color channel. Color filters on each pixel are arranged in a regular mosaic pattern. Values for the two missing color values for each pixel are derived by interpolating between the values of neighboring pixels. Compare with YUV.
RTC	Real-Time Clock. The on-camera clock.
RTP / RTSP	Real-Time Transfer Protocol / Real Time Streaming Protocol.
Telnet	Teletype Network. A network protocol that provides means to communicate with a remote computer through a command-line console client application. The camera supports a telnet daemon for this purpose.

UDP	User Datagram Protocol. The data throughput for Lumenera Network cameras over HTTP is 1.5 MB/s and about 50% greater over UDP. The speed of UDP is due to the lack of overhead for checking if every packet reaches its destination. Packets may arrive out of order or fail to arrive without notice.
URI or **URL**	Uniform Resource Identifier, Uniform Resource Locator. A URL such as http://www.lumenera.com is a type of URI that identifies a resource and the particular representation of that information.
UTC time	Coordinated Universal Time. The Lumenera Network cameras use UTC time to account for the time zone and changes between Daylight and Standard Time.
YCbCr and **YUV**	Alternative color spaces to `RGB` in which the image components are the luminance or "luma" (Y) and the color ("chroma") values Cb and Cr, or U and V, respectively. The Y component is related to the overall brightness and is a combination of the R, G, and B values. In an analog composite video signal, the Y component is sufficient to display monochrome (black & white) images.
YUY2	A format for image information in which luma (Y, "brightness") is encoded for each pixel, but chroma (Cb, Cr, "color") information is provided only for every second pixel.
XML-RPC	Extensible Markup Language-Remote Procedure Call. A simple protocol for making remote procedure calls. XML is used to encode the calls and HTTP is used for transport. The installation CD-ROM includes XMLRPC libraries for C++ and Visual Basic.

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